





PROCEEDINGS
of the
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of
WASHINGTON

Volume 79

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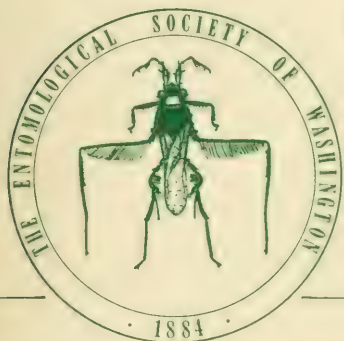
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THE ALAN STONE COMMEMORATIVE ISSUE

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THE
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OF WASHINGTON

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No. 1

DEDICATION OF THIS ISSUE TO ALAN STONE

The Entomological Society of Washington has been exceptionally fortunate in having had, since its founding in 1884, a vast number of dedicated members. With this issue of the *Proceedings*, we take pleasure in honoring one of our most outstanding members, Dr. Alan Stone, on the occasion of his 73rd birthday. Alan has contributed in many ways to the Society: as an active member since 1931, as Editor from 1943 to 1947, as President in 1951, and as a benefactor.

Alan Stone's scientific work needs no testimonial—the merit of his work rests securely on his many outstanding research publications and the extensive taxonomic services that he has given to others throughout the world. In his honor, we have invited a number of his colleagues to contribute papers to this special issue. It would have been far from possible to have papers from everyone who should be included, so we have tried to include representatives for several of Alan's areas of interest.

Alan, a native of Brooklyn, New York, spent part of his youth in Canaan, Connecticut, and received his Bachelor's degree from Cornell University in 1926, graduating with Louise Stone and another Entomological Society of Washington member, Louise Russell. After completing a Ph.D. in 1929, studying the taxonomy of Tabanidae under Robert Matheson at Cornell, Alan joined the faculty at Dartmouth College. In 1931 he joined the USDA taxonomy group in Washington, retiring from the successor organization, the Systematic Entomology Laboratory, in 1973.

Alan's scientific accomplishments are too extensive to recount here, but a few highlights may be mentioned: his revisions of the Tabaninae (1938), *Anastrepha* (1942), and the Oriental Haematopodini (1974), several important works on Simuliidae, and the synoptic catalog of world mosquitoes (1959). Alan was one of the chief instigators and major contributors to the monumental Catalog of North American Diptera (1965). Certainly of equal importance have been the many authoritative and prompt identifications and other information that he has provided for many people throughout the world, as well as his leadership in the Systematic Entomology Laboratory.

Especially for those of us who have had the good fortune to work



Alan and Louise Stone, November, 1976
(photo by T. J. Spilman)

with Alan on a day-to-day basis, the exemplary manner in which he has carried out the varied duties of a research taxonomist in the USDA has been an inspiration, a model of excellence.

Still very much a part of the Washington group of entomologists, Alan has had an opportunity, since retirement, to pursue his many other interests, and, as customary, with fervor. Washington area members of the Society have enjoyed the company of Alan and Louise Stone at many meetings and functions over the years, and we hope to do so for a long time into the future.

LLOYD KNUTSON

Editor, Proceedings of the Entomological Society of Washington
Chairman, Insect Identification and Beneficial Insect Introduction Institute,
Beltsville Agricultural Research Center, USDA

THE SUBORDERS OF DIPTERA

HAROLD OLDROYD

88 Park Ave. E., Ewell, Epsom, Surrey, England KT17 2PA

ABSTRACT—The higher classification of the Diptera is considered, with special reference to the recent classification proposed by Boris Rohdendorf. A redeployment of the families of Diptera into three major groups, which may reflect more of a natural evolutionary pattern than the conventional Suborders is proposed. These are the Suborders Superstata, Madescata, and Areseata.

“A critical examination of all existing schemes proposed during the 150 years of study of the Diptera shows that most of them were based upon either a single feature or a group of structural characteristics. Each author proposing and defending his own system has usually not attempted to evaluate the categories that he was establishing in any ecological or ethological sense”. Rohdendorf (1974, p. 17).

The student is told that Diptera are classified into three Suborders, but he is given only unsatisfactory reasons for making these divisions. The explanation by Imms (1957, p. 607) is typical, “The Diptera may be classified into three suborders, viz. the Nematocera, Brachycera and Cyclorrhapha. The first mentioned include the most primitive forms, the Cyclorrhapha comprise the most highly specialized while the Brachycera occupy in some respects a position intermediate between these two groups. In the time-honoured classification of Brauer two suborders are recognized, viz. the Orthorrhapha (including the Nematocera and Brachycera) and the Cyclorrhapha. These differ rather in the absence or development of a puparium than in the method by which the imago escapes from the pupa, the feature stressed by Brauer.”

Then follow summaries of characters for the three Suborders, but with many qualifications and exceptions. The aforesaid student, therefore, cannot run down an unknown fly in any systematic way, but must wait until he is familiar with the appearance of at least the larger families.

Other authors have attempted to construct keys that would lead directly to the Suborders. Thus Colless and McAlpine (1970, pp. 678–679) make a primary division into Nematocera and Brachycera, further dividing the latter into Orthorrhapha and Cyclorrhapha, but the characters used are full of hesitations and qualifications. The first half of the first couplet, defining Nematocera, includes the words ‘relatively’, ‘often’, ‘rarely more or less’, ‘usually (rarely reduced)’, ‘rarely’, ‘often’, ‘except in some . . .’, and ‘mostly’—all in five lines of print.

This is a commentary on the insects, not the authors. In the same

year I attempted to do the same thing (Oldroyd, 1970, p. 65), starting at the other end of the Order, and first eliminating all the flies with a ptilinal suture as Cyclorrhapha-Schizophora. This is a step forward, but the further analysis into Nematocera, Brachycera and Cyclorrhapha-Aschiza is just as unconvincing as those of other authors. On an earlier page (1970, p. 63) I glossed over this difficulty with the bland phrase: "In practice one seldom needs to use the keys to determine the Suborders . . ."

One wonders, therefore, whether the 'time-honoured classification' into Nematocera, Brachycera and Cyclorrhapha serves any useful purpose. It was with some curiosity on this point that I approached Rohdendorf's book *The Historical Development of the Diptera*, the English translation of which has now appeared, and which I had the privilege of seeing during its editorial stages.

Rohdendorf recapitulates the Nematocera/Brachycera and Orthorrhapha/Cyclorrhapha divisions, discussing their validity (pp. 18-20), and reaches the familiar conclusion that: "Only Nematocera on the one hand and Cyclorrhapha in the narrow sense on the other, can be formally defined. 'Brachycera' and 'Orthorrhapha' overlap with these, because Brachycera includes both orthorrhaphous and cyclorrhaphous forms, while Orthorrhapha may be either nematocerous or brachycerous." Nor does internal anatomy give any clearer guidance. Neither the number of Malpighian tubules nor the structure of the vascular system is consistent with either of the two customary divisions of the Order. Hence: ". . . we can draw certain quite definite conclusions. The suborders Nematocera, Brachycera-Orthorrhapha and Cyclorrhapha, as they are widely accepted by almost all taxonomists, *are not natural groups*" (my italics).

The last four words are the important ones. As long as we believe that the three Suborders bring the Diptera into groups of naturally related families we can accept the difficulty of precisely defining them. Indeed this is what we should expect when we are attempting to subdivide such a diverse Order of insects. If, however, these Suborders can neither be adequately defined nor believed in, then what use are they?

In an earlier paper addressed to the XIth International Congress of Entomology Rohdendorf (1961) had separated off the strange family Nymphomyiidae as sole representative of the Suborder Archidiptera, and lumped all the rest into the single Suborder Eudiptera. In effect he abandoned any attempt to form Suborders, and classified Diptera directly into thirteen *infraorders*, each named after a typical family: thus *Bibionomorpha*.

Since my working life has been spent studying the taxonomy of the Brachycera-Orthorrhapha I looked with particular attention at these families, and found that Rohdendorf retained them in a single infra-

order, Asilomorpha. This is not consistent with my own conclusions, which are based upon biological as well as structural considerations, as advocated by Rohdendorf himself in the passage quoted at the head of this article. By a coincidence, in the same year (1964) as the original Russian text of Rohdendorf's book appeared, I published a book called *The Natural History of Flies* in which I attempted to trace an evolutionary pattern in the biology and life-history of the various groups of Diptera. I arrived at the general conclusion that: "It seems to me more helpful to look upon the larva as an ancillary stage, relieving the adult of most of the laborious and protracted feeding needed during the life of an individual. Those adults that have continued in the primitive bloodsucking habit like the mosquitoes and blackflies, and those that have reverted to predaceous or bloodsucking habits like the robber-flies and tsetse-flies, are thereby supplementing an inadequate diet. In other words the adults, where necessary, make up for the deficiencies of the larva, not the opposite." (Oldroyd, 1964, p. 25).

This same theme is central to Rohdendorf's book, and constitutes the 'conflict' that he envisages as having to be resolved during the evolution of every family of flies. For example: ". . . insufficiency of larval food was one of the oldest problems to arise in the evolution of Bibionomorpha" (p. 64), and again, speaking of the Fungivoridea (p. 65): "These features suggest that the chief evolutionary problem to be overcome was once again insufficiency of larval food, leading to perfection of the winged phase." Most taxonomists will study *The Historical Development of Diptera* to see which of their favourite families are merged, or (more often) split up, but these decisions are personal, and ephemeral, and are already more than ten years out of date. The lasting contribution of Rohdendorf's book lies in his illuminating comments on the implied way of life of the Diptera of the past, and its relevance to the composition of the surviving fauna. Can we not apply this method, using a combination of structural and ecological data, to suggest some major subdivision of the Eudiptera that will be more meaningful than the traditional three Suborders?

The grouping of all the families of Brachycera-Orthorrhapha into one infraorder Asilomorpha obscures the very obvious differences that exist between the families related to Tabanidae, Rhagionidae and Stratiomyidae, and all the rest. Indeed, if we stand, as it were, at this center point of the Order Diptera, we look backwards with Tabanidae and others into the Nematocera, and forwards with Asilidae and Bombyliidae into the higher Diptera. It was from this viewpoint that I divided the Brachycera-Orthorrhapha of the British fauna into two superfamilies only, Tabanidea and Asilidea (Oldroyd, 1969, p. 2), and suggested that Tabanidea should be compared with the 'watery', bloodsucking groups of Nematocera rather than with the Asilidea.

Certainly there are differences, both adult and larval, between Tabanidea and Culicimorpha, but there are two significant points of resemblance; they have predominantly aquatic larvae, and Rhagionidae and Tabanidae, at least, have many mandibulate, bloodsucking females. There have long been arguments whether the latter is a persistence of an archaic habit, or whether it has arisen many times independently during the evolution of Diptera. I believe that it has arisen only once, and that therefore all groups which include mandibulate, bloodsucking females are descended from a single stock. I believe this because the mandibulate, piercing mouthparts are so essentially similar in all the families in which they occur. There are many examples of the *loss* of mandibles even in particular genera and species (e.g. *Sphecodemyia* in Tabanidae), but no known example of a parallel development of mandibles. From Asilidae onwards piercing and bloodsucking occurs sporadically, and by means of entirely new equipment; in Asilidae and Empididae based upon the hypopharynx, in Dolichopodidae and some Muscidae by a combination of crushing labella and either prestomal or pseudotracheal teeth. Similarly, in these families from Asilidae onwards, when aquatic larvae occur, as in Syrphidae and Ephydridae, this can be explained as secondary migration to water by essentially terrestrial stocks. At no point anywhere near to these families can one trace an aquatic ancestry.

It seems, therefore, that relationships among the families of Diptera would be better understood if the grouping of Brachycera-Orthorrhapha were to be abandoned, but this could hardly be done by simply assigning Tabanidea to 'Nematocera' and Asilidea to 'Cyclorrhapha'. New terms would be needed, and might be associated with a fundamental rearrangement. The concept of 'Nematocera' is handy because it is easily understood ('threadhorns'), but difficulty has always arisen because a number of primitive 'Brachycera' have multisegmented antennae: e.g. *Rhachicerus*, and many Stratiomyidae, and in existing keys we have to resort to subterfuges such as the vagaries of the anal vein to justify excluding these from Nematocera.

Rohdendorf repeatedly stresses the disparity between two main lines of evolution among Nematocera, and concludes (p. 24) that: "On the whole therefore, the suborder 'Nematocera' does not possess any real unity, but consists of an assembly of groups of superfamilies not directly related to one another. He does, however, recognise some degree of grouping into 'Oligoneura', centering around Bibionidae, and 'Polyneura' centering around Culicidae. These are what I have called the 'earthy' and 'watery' groups respectively. I applied these names, rather than 'terrestrial' and 'aquatic', to avoid the natural criticism that both groups include many Diptera the larvae of which live in intermediate habitats, neither terrestrial nor aquatic: e.g. in the debris in a rot-hole in a tree. Yet I think that there is a real distinction

between them, once we have left behind the Tipulidae and a few closely related families, where there is still such a wide range of larval habitats that we can only regard them as preserving, as it were, an ancestral uncertainty of evolutionary direction.

I suggest, therefore, that we should again group the superfamilies of Diptera into three Suborders, but radically different from the traditional ones, and based upon general ecology and habits, rather than directly on structural grounds. These would be:

1. Tipulidae and those related families that can be regarded as relicts from the original basic group of Diptera (Oldroyd, 1964, pp. 29–40). They would comprise the superfamilies Pachyneuridea and Tipulidea of Rohdendorf (1964, 1974, p. 9). Suggested name: Suborder SUPERSTATA, from *superstes*, surviving.

2. All the 'watery' families, with characteristically aquatic larvae, and including all those with any mandibulate, bloodsucking females. Superfamilies Psychodidea, Culicidea, Dixidea, Chironomidea, Orphnephiliidea and Rhaetomyiidea of Rohdendorf (1964, 1974, pp. 9–10) *plus* Tabanidea and Stratiomyiidea (ibid, p. 11). Suggested name: Suborder MADESCATA, from *madescere*, to become moister, to tend towards wetness.

3. All the rest of Diptera, which are essentially terrestrial, even though some of them have secondarily returned to water as a larval habitat. When they have also re-acquired the bloodsucking habit, this is carried out by other structures than mandibles, and is common to both sexes. This Suborder includes the 'earthy' groups of 'Nematocera', and all the Diptera from Asilidae onwards: suborders Bibionomorpha, Asilomorpha (less Tabanidea and Stratiomyiidea), Musidoromorpha, Phoromorpha, Termitoxenioromorpha, Myiomorpha, Braulomorpha, Streblomorpha, Nycteribioromorpha of Rohdendorf (1964, 1974, pp. 10–14).

Suggested name: Suborder ARESCATA, from *arescere* to dry up.

Rohdendorf sets up separate infraorders for the two families of 'mountain midges', Blepharictridae and Deuterophlebiidae. There are no known fossils of these, but the evidence of the living forms, adults and larvae, leads him to associate each of them with his superfamily Chironomidea. This would place them in the Madescata of our grouping.

Three families of Rohdendorf's Asilomorpha call for special mention. It will be noted (p. 11) that he assigns Nemestrinidae to Tabanidea and Acroceridae to Stratiomyiidea. Because these two families have a padlike empodium ('three pulvilli') they have traditionally been placed in Hendel's Homeodactyla, in contrast to Asilidae and the rest which have the empodium bristlelike, and were classed as Hetero-

2. MADESCATA

larvae predominantly
aquatic:

mandibulate females
in many groups

Psychodidea

Culicidea

Dixidea

Chironomidea

Blephariceridea

Deuterophlebiidea

Orphnephilidea

Rhaetomyiidea

*Tabanidea*¹

*Stratomyiidea*¹

water midges, gnats,
mosquitoes, horse-flies

1. SUPERSTATA

larvae not predominantly
either aquatic or terrestrial:
no mandibulate forms
survive.

Pachyneuridea

Tipulidea

crane-flies and related
families.

3. ARESCATA

larvae in drier media;
some have become secondarily
aquatic:

no mandibulate piercing.

Nycteribiomorpha

Streblomorpha

Braulomorpha

Myiomorpha

Termitoxeniomorpha

Phoromorpha

Musidoromorpha

*Asilomorpha*¹

Bibionomorpha

land midges

'flies'

ancestral Diptera

larvae in moist media, neither
truly aquatic nor terrestrial:
mandibles present in some

¹ with the exceptions discussed in the text

dactyla. I think that this is a superficial and misleading association, and an example of the excessive reliance on a single structural character against which Rohdendorf himself has warned us. It seems to me that both adult and larval characters relate these two families to Bombyliidae (Oldroyd, 1964, p. 134; 1969, p. 107), and hence they should be removed to Rohdendorf's superfamily Bombyliidea, where he has split Bombyliidae in the usual sense into four families (Bombyliidae, Usiidae, Cyrtosiidae and Systropodidae). This is in accord with many current workers on this group, who consider that these groups are too disparate to be retained in one family. There is, as yet, no consensus of opinion as to the details of this fragmentation, and I suggest that Nemestrinidae and Acroceridae should also be considered as part of this complex.

A third problematical family is Scenopinidae, which have been closely linked with Therevidae because their larvae are at once so similar and so unlike any others of the Asiloidea. Therevidae seem correctly placed close to Asilidae, but I have long thought that Scenopinidae are more like Stratiomyidae, especially about the head (Oldroyd, 1969, p. 104). Rohdendorf (p. 88) refers to them as 'the relict family Scenopinidae, which out of the contemporary Asilidea is probably the group most closely related to the original form of the subfamily'. I would go further, and suggest that they may be regarded as a terrestrial offshoot of Stratiomyiidea, perhaps analogous to Vermileoninae, which are a terrestrial offshoot of Rhagionidae, and which some authors would segregate into a distinct family.

The object of the present paper is to suggest a redeployment of the families of Diptera into three major groups, which may reflect more of a natural evolutionary pattern than the conventional Suborders. For this purpose I have used the superfamily names employed by Rohdendorf (1964, 1974), and to facilitate reference to his book I have retained the unusual ending *-idea*. Apart from what I have said above, I express no views about the assembly of families within these superfamilies. This is a very big question, and no two authors agree, as will be seen by comparing Rohdendorf's list with those of Imms and the *Insects of Australia*.

There is however, a growing measure of agreement among dipterists for the overall pattern, and it is hoped that the suggestions given in this paper, may contribute to this. We may end, as we began, with a quotation from Rohdendorf (p. 290): "The further history of the Diptera i.e. after Lower Triassic times consists, in fact, only of the fortunes of two of the infraorders—the aquatic tipulomorphs [i.e. my Superstata + Madescata] and the terrestrial bibionomorphs [my Arescata] . . . which gave rise to the younger infraorders widespread in the Cenozoic".

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NOTE

THE TAXONOMIC STATUS OF PORTACHORUTES WRAY
(COLLEMBOLA: NEANURIDAE)

The genus *Portachorutes* was erected by Wray (1953, J. Agr. Univ. P. R. 37: 140-150) for the Puerto Rican species *Portachorutes mambatus*.

Massoud (1967, Biol. Amer. Australe. 3: 1-399) and Rapoport (1971, Pacif. Ins. Mon. 25: 99-118) regarded this monotypic genus as of dubious taxonomic status. The former author omitted the genus from his monograph of the Neanuridae (first reference above). On the other hand, Salmon (1964, Bull. Roy. Soc. New Zealand. 7: 1-651) and Mari Mutt (1976, J. Agr. Univ. P. R. 60: 113-128) regarded the genus as valid.

A detailed study of specimens collected in Puerto Rico has shown that *Portachorutes* is a synonym of the genus *Arlesia* Handschin (1942, Ver. Naturf. Ges., Basle, 53: 265-284) since *P. mambatus* is a synonym of *A. albipes* Folsom (1927, Proc. U. S. Nat. Mus. 72: 1-16), the type species of *Arlesia*. The Puerto Rican specimens, in addition, fit well the redescrptions of the latter species furnished by Denis (1931, Boll. Lab. Zool. Portici 25: 69-170) and Massoud (1963, Stud. Fauna Surinam and other Guyanas. 6: 43-51).

Due to the great value of Massoud's 1967 monograph, I find it desirable to publish the aforementioned synonymies in order to fill this gap in the cited work.

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**A NEW SPECIES OF ERIOPTERINE CRANE
FLY FROM ECUADOR (DIPTERA: TIPULIDAE)**

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ABSTRACT—*Erioptera* (*Erioptera*) *alanstonei* is described from Ecuador.

I am honored in being invited to contribute an article to the series of papers being prepared to commemorate the retirement of Dr. Alan Stone. He will long be remembered for his outstanding papers in the order Diptera and similarly for the kind advice and assistance extended to many students of flies. I express my gratitude to him for assistance on many occasions throughout the years.

For this paper I have selected an interesting species of the genus *Erioptera* from Ecuador and have given the name *alanstonei* to this fly. The types of the novelty are placed in the Alexander Collection of crane flies that will be deposited in the United States National Museum where Dr. Stone spent much of his life while studying the Diptera.

Erioptera (*Erioptera*) *alanstonei* Alexander, new species

General coloration of thorax obscure yellow, praescutum with 4 dark brown stripes, intermediate pair united with laterals at their anterior ends, pleura dark brown with broad silvery longitudinal stripe; knobs of halteres brown; legs yellow, femora with narrow blackened subterminal ring that is about 3 times as long as pale apex; wings almost uniformly brownish orange, variegated by yellow and slightly more darkened areas; veins pale, difficult to distinguish against the ground; abdomen dark brown; male hypopygium with 2 terminal dististyles, outer one deeply forked, inner style simple; phallosome with gonapophyses appearing as long narrow yellow blades, narrowed gradually to acute tips.

Male, length about 5–5.5 mm; wing 5–6 mm; antenna about 0.9–1.0 mm.

Female, length about 6 mm; wing 5 mm.

Rostrum, palpi and antennae black; flagellar verticils long, head brown.

Pronotum and pretergites yellow. Mesonotal praescutum obscure yellow with 4 conspicuous dark brown stripes, longer intermediate pair about $\frac{1}{2}$ broader than median ground line, united at anterior ends with shorter lateral stripe; scutal lobes pale with dark brown median and lateral areas; scutellum and postnotum obscure yellow. Pleura dark brown, with broad silvery longitudinal stripe extending from behind fore coxa to abdomen, dorsally broadly bordered by brownish black, ventrally with narrower dark brown line that involves dorsal sternopleurite, meron and metapleura, ventral sternopleurite light brownish gray; dorsopleural region broadly pale. Halteres with stem whitened, knob brown. Legs with fore coxae darkened, remaining coxae and all trochanters pale; femora yellow with single broad blackened subterminal ring that is about 3 times as extensive as pale apex; tibiae and tarsi yellow, outer segments of latter slightly darkened. Wings (fig. 1) almost uniformly brownish orange, prearcular and

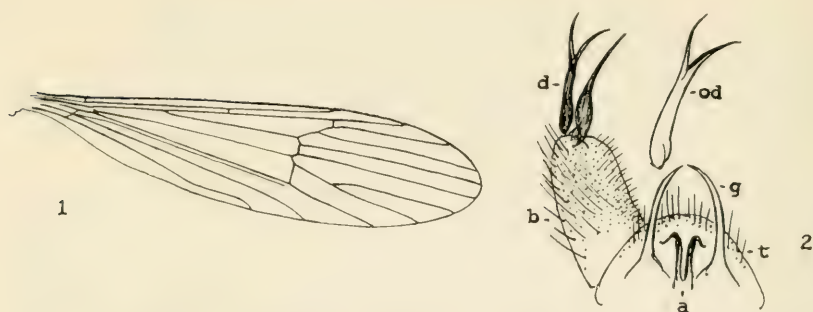


Fig. 1, 2, *Erioptera (Erioptera) alanstonei*. 1, venation. 2, male hypopygium. Symbols: a, aedeagus; b, basistyle; d, dististyles; g, gonapophysis; od, outer dististyle; t, 9th tergite.

basal costal fields light yellow; outer half of wing and base of cell 2nd A slightly darker than remainder of ground, cell R somewhat more yellowed; vague more whitened areas at forks of veins M and M_{3+4} ; stigmal region slightly more darkened; veins pale, difficult to distinguish against ground. Venation about as shown; vein 2nd A only slightly sinuous.

Abdomen dark brown. Male hypopygium (fig. 2) with posterior border of tergum broadly convex, margin with long yellow setae. Dististyles, d, terminal; outer style, od, a long curved black spine, at near $\frac{2}{3}$ its length on outer face with similar long spine; inner style somewhat shorter, base expanded, thence produced into long, nearly straight spine. Phallosome, p, with apophyses, g, appearing as long narrow yellow blades that narrow gradually to acute tips. Aedeagus, a, with outer arms strongly recurved, divergent at outer ends.

Holotype, ♂, Ecuador, Azuay, South Cuenca, Cordillera Tinajillas, 3100 meters, March 18–19, 1965 (Luis E. Peña). Allotopotype, ♀. Paratopotypes, 4 ♂♂, with the types.

This attractive crane fly is named in honor of Dr. Alan Stone, outstanding student of the Diptera, particularly the Nematocera. It is most readily told from other regional species by the color pattern of the thorax, wings and legs, and in hypopygial structure. In the last character it is most similar to *Erioptera (Erioptera) dampfi* Alexander, of Mexico, differing in the coloration of the thorax and legs and in hypopygial details. It may be noted that in the wing and leg coloration, and in the general structure of the hypopygium, the present fly shows certain points of resemblance to species in the subgenus *Mesocyphona* Osten Sacken, similarly well represented in Tropical America, but the venation indicates that it is best referred to the typical subgenus.

In Alexander and Alexander (1970) 18 species were included in the subgenus *Erioptera* of which four are known to occur in Ecuador, *E. (E.) acucuspis* Alexander, *E. (E.) celestis* Alexander, *E. (E.) poly-*

tricha Alexander, and *E. (E.) urania* Alexander, all readily distinguished from the present fly by coloration and hypopygial details.

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BOOK REVIEW

Criddle-De-Diddle-Ensis. A Biographical History of the Criddles of Aweme, Manitoba, Pioneers of the 1880's. 1973. by Alma Criddle. 288 pp., 24 photos. Soft cover. Published by and available from Miss Alma Criddle, 19-303 Furby St., Winnipeg, Manitoba, R3C 2A8, Canada. \$8.00.

This book describes an exceptional pioneer family in Manitoba which included Norman Criddle (1875-1933; for obituary, list of publications, and portrait see *Canad. Entomol.* 65: 193-200, 1933), who was an outstanding entomologist as well as a notable general naturalist. To readers familiar with the literature of grasshopper biology and control, as well as the growth of information on Canadian insect distribution through *The Entomological Record* (*Ann. Repts. Entomol. Soc. Ontario*) for many years, the name of Norman Criddle will be remembered; they will recall a host of insect records from Aweme, where the family farm was located and where an entomological laboratory was established primarily for his use. Another locality often cited is Treesbank; these places are about 25 miles southeast of Brandon, Manitoba, near the North Dakota boundary.

The Criddle family came to Manitoba as homesteaders from England in 1882, the father not experienced as a farmer but rather a small merchant who had been educated partly at Heidelberg, Germany. The mother likewise was a well educated, cultured person, and their children were schooled primarily at home. Apart from the interest in Norman and other talented members of the family, the book is a warm personal account, largely drawn from diaries, of a closely knit family who enjoyed sports, music, the wildlife about them, and altogether a varied balanced life in spite of pioneer hardships. Miss Alma Criddle, a niece of the entomologist, is to be commended for a thoroughly fine work and valuable historical document.

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A REMARKABLE NEW SPECIES OF LEUCOPIS FROM WESTERN
CANADA (DIPTERA: CHAMAEMYIIDAE)

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ABSTRACT—*Leucopis astonea* is described from the Okanagan Valley of southern British Columbia.

Members of the family Chamaemyiidae, sometimes called silver-flies (Tanasijtschuk 1970a), are important because their larvae prey on Homoptera of the superfamilies Aphididoidea and Coccoidea. Their role in the biological control of certain pest species, e.g., the balsam woolly aphid, *Adelges piceae* Ratz., has led to a considerable amount of taxonomic and biological work in recent years. Selected references include the following: Babaev and Tanasijtschuk 1971; McAlpine 1963, 1971; McAlpine and Tanasijtschuk 1972; Sluss and Foote 1971, 1973; Smith 1963; and Tanasijtschuk 1968, 1970c, 1971, 1972, 1974.

Of the 20 or so genera and subgenera that make up the family (McAlpine 1960, Tanasijtschuk 1970b), the genus *Leucopis* sens. lat. is by far the largest and the most common. Adults of most of the species that belong to it are notoriously difficult to recognize because of their small size, uniformity of general appearance, and lack of easily detectable taxonomic characters. In describing the species *L. flavicornis*, Aldrich (1914) stated that "specific characters of the genus *Leucopis* are so obscure and uncertain that one is almost inclined to doubt whether the half dozen species from North America are not really forms of the same one". This is certainly an overstatement but it points up a basic problem in classifying these flies. Today there are about 25 species recorded in the Nearctic Region, and probably several times that number remain to be described.

A new species from British Columbia differs markedly from its congeners in having some rather astonishing features, especially on the head of the male (fig. 1) and female (fig. 2). It is a pleasure to describe such a distinctive member of the genus in honour of Alan Stone, who throughout his long and productive career has made so many outstanding contributions to Dipterology.

Leucopis (Leucopis) astonea McAlpine, new species

Diagnosis: Small, greyish-black species with black antennae, black palpi, uniformly greyish pruinose mesonotum, subshining metallic-black abdomen, milky wings, and yellow tarsi; male with hornlike clump of long setulae on each side of anterior margin of frons (fig. 1); female with palpi greatly enlarged and spatulate (fig. 2).

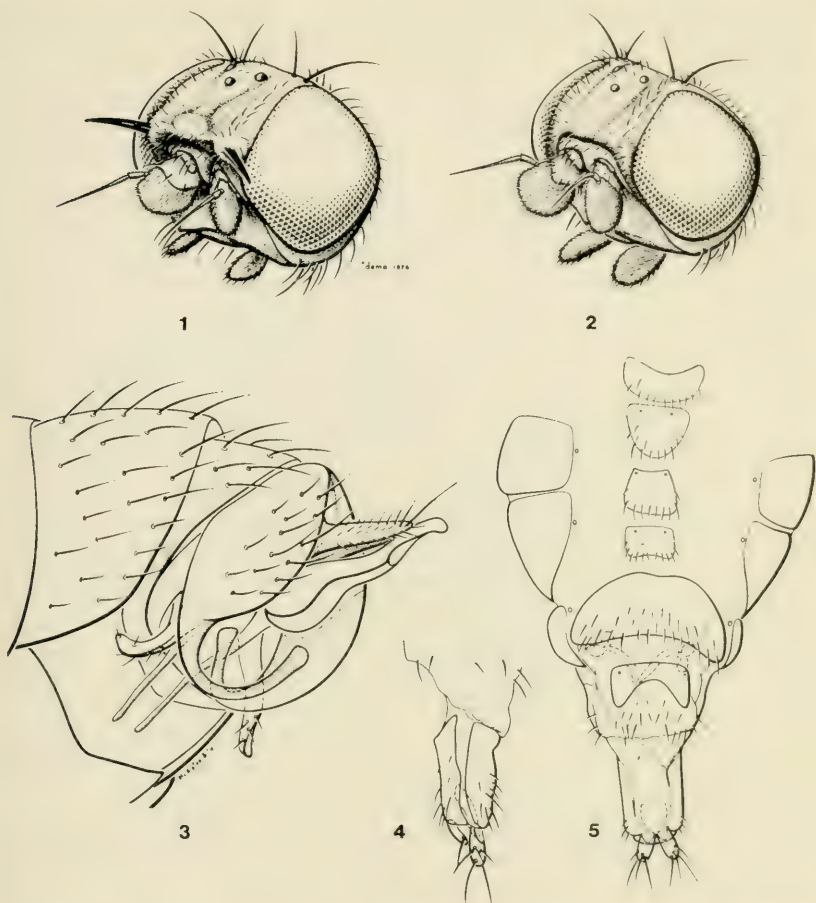


Fig. 1-5, *Leucopis astonea*. 1,2, heads of ♂ (holotype) and ♀ (allotype), respectively, left anterolateral aspect. 3, male genitalia (holotype), left postero-ventral aspect. 4,5, female genitalia (paratype), left lateral and ventral aspects, respectively.

Male: Length about 2.5 mm. Head (fig. 1) almost as long as high, distinctly broader than high. Frons longer than broad, sides diverging from vertex to bases of antennae, anterior margin protruding rooflike above lunule, each side with more or less double row of 7 or 8 tiny, black, outwardly-directed setulae; lower end of each row with pencil of 5-6 relatively long, closely-appressed, antero-laterally-directed, blackish hairs; anterior margin of frons, at middle, with transverse, oval, orange-colored, densely silvery pubescent, sensory spot; middle of frons with large, subshining, frontal plate extending from behind posterior ocelli to median orange spot, its sides gently converging to lateral extremities of orange spot, its disc relatively sparsely pruinose and with sparse, very short, convergent,

whitish hairs. Ocelli reddish, forming a nearly equilateral triangle. Outer verticals at least twice as long and strong as inner ones. Postverticals absent. Lunule shining black on lower half, greyish pruinose along upper border. Face uniformly blackish-grey pruinose, with a graphitelike shininess. Antennae entirely black; 3rd segment almost twice as wide as long on inner face; arista scarcely twice as long as width of 3rd antennal segment; 2nd segment strongly swollen, twice as long as greatest diameter.

Eye slightly higher than long, margin along parafacial rather strongly flattened. Cheek unusually narrow, shortest distance from subcranial cavity to eye margin about $\frac{1}{2}$ width of 3rd antennal segment, with 4 or 5 longish setulae arising posteroventrally. Clypeus shining black. Palpi black, flattened, somewhat spatulate, projecting anterolaterally, inner surface rather silvery shiny.

Thorax uniformly dull, ashy-grey pruinose. Mesonotum uniformly setulose, with 8–10 irregular rows between dorsocentral bristles, these conspicuously sparser in middle at anterior margin of mesonotum and not extending caudad beyond bases of posterior dorsocentral bristles; following bristles present on each side: postpronotals (= humerals) 1, presutural intraalars (= posthumeral) 1, notopleurals 2, postsutural supraalars 2, postsutural intraalars 1, postsutural dorsocentrals 2; anterior dorsocentral about half as long as posterior one. Prescutellar acrostichals absent. Proscutellum strongly developed. Scutellum with the usual 4 bristles. Katepisternum (= sternopleuron) with 1 bristle at upper posterior angle, preceded by several setulae; all other pleural sclerites completely devoid of hairs or bristles. Prosternum broad, somewhat heart-shaped, greyish pruinose, otherwise bare.

Wings dusky-whitish with dark-brown veins. Costa extending to M_{1+2} . Anterior crossvein (r-m) meeting discal cell (1st M_2) near distal third; distance between r-m and posterior crossvein (m-cu) scarcely longer than length of m-cu, and slightly shorter than apical section of M_{3+4} . Halter with yellowish stem and white knob. Calypter white with pale yellow margins and fringes. Legs mainly blackish; extreme apices of all femora yellowish; front and hind tarsi with 2 basal segments yellow; mid tarsus with 3 basal segments yellow.

Abdomen with dorsum very thinly pruinose throughout, entirely subshining black with dark-greenish, metallic lustre in most lights, uniformly coarsely setulose; tergites 2–5 about equal in length.

Genitalia (fig. 3) relatively massive. Epandrium with unusually long, slender, incurved surstylar lobes. Pregonite elongate, with somewhat spatulate, outwardly-directed apex. Postgonite long and slender, spikelike in form. Cerci caudally-directed, extending rooflike over tip of aedeagus. Aedeagus with a broad, stout base, tapering to slender apex; with a suddenly recurved, spoutlike tip.

Female: Agreeing with male in most respects but with following differences: Head (fig. 2) much higher in relation to length. Frons not projecting beyond lunule, meeting latter almost at right angles, with neither specialized pencils of long hairs at anterolateral angles nor discrete sensory area in middle of anterior margin. Face pale silvery pruinose. Palpi greatly enlarged, approaching size of 3rd antennal segment. Abdomen somewhat more thinly pruinose dorsally, and shinier. Genitalia (fig. 4, 5) similar to those of *argenticollis* Zetterstedt (McAlpine and Tanasijtschuk, 1972). Sternum 6 wholly dark-brown to black, heavily sclerotized, and with numerous setulae on posterior half; sternum 7 fairly strongly sclerotized, and deeply emarginate in middle posteriorly. Tergum

7 very weakly sclerotized. Cerci short, strongly divergent, with fine sensory hairs. Spermathecae 2 pairs, small, slightly oval.

Immature stages and biology, unknown.

Types: Holotype ♂, allotype ♀ and one paratype ♀, Vasseau Lake, nr. Oliver, British Columbia, May 14, 1959, R. E. Leech. Deposited in the Canadian National Collection of Insects, Ottawa.

Remarks: *Leucopis astonea* differs from all other known members of the genus in the following peculiar characters: Frons in both sexes with a large, weakly-shining, frontal triangle which extends broadly to lunule; each side of frons with a more or less double row of conspicuous, black, outwardly-directed setulae; male frons with a unique, hornlike pencil of long, appressed hairs projecting from each anterolateral angle, and with a discrete, transverse, oval, orange-colored, sensory area in middle of anterior margin; palpi, especially in female, greatly enlarged. The relationship of *astonea* to other species of the genus is still somewhat obscure, but certainly it belongs in the diverse group of species, including *L. argenticollis* Zetterstedt, *L. atritarsis* Aldrich and *L. piniperda* Malloch, whose larvae are predators of Adelgidae on conifers. All these species have a relatively large, elongate frontal triangle, relatively broad lateral frontal plates bearing rows of fine setulae or hairs, and the frons usually meeting the lunule at a rather sharp angle. In addition, the mesonotum always lacks sublateral brown stripes, and in the female, sternum 6 is heavily sclerotized and sternum 7 is deeply emarginate posteriorly. *Leucopis astonea* shares all these features with them.

The name, *astonea*, is derived from the Middle English word *astonien*, to astonish, astound; happily, and hardly by coincidence, it contains "A. Stone", to whom the species is dedicated.

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A NEW HAEMATOPOTA FROM NEPAL (DIPTERA: TABANIDAE)

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ABSTRACT—A new tabanid fly, *Haematopota stonei*, is described from Nepal.

A new species of biting flies is described from Nepal, where it was found to be abundant and annoying to man and domesticated elephants. Stone and Philip (1974) have recently published a monograph of the Oriental species of the tribe Haematopotini. My new species is described with reference to that publication.

Haematopota stonei Thompson, new species

Female.—Length: 8.3–10.4 mm (average 9.8 mm); wing 8.5–10.3 mm (9.7 mm); antenna 1.7–2.1 mm (2.0 mm) (18 specimens measured).

Head: Frons gray, brownish near vertex, about $\frac{3}{4}$ as wide at vertex as high, distinctly wider below; midfrontal spot usually absent, rarely indistinctly brownish; paired spots black, usually subtriangular, separated from eyes and callus; callus usually black, rarely partially brownish orange, with lower corner just touching eye or very narrowly separated from it, with upper margin trilobed, with lower margin deeply concave; interantennal spot strong, black; face and lower parafacials pale grayish white, rarely with slight trace of an incomplete blackish band across upper face; upper parafacials solid black; beard white. Scape about 2 times as long as height at apex, slightly narrowed toward base, yellowish on basal $\frac{2}{3}$ and ventrally, black dorsoapically, all grayish-white pollinose, mainly long black pilose, with a few long white ventral hairs; pedicel light yellowish orange, black pilose, with dorsal projection strong; flagellum brownish orange, except apical flagellomere dark brown on apical $\frac{1}{2}$; 1st flagellomere compressed, with its greatest height slightly greater than length of style, with its length subequal to that of scape; apical flagellomere about as long as 2nd and 3rd together. Palpus pale orange white, light grayish-white pollinose, white and black pilose.

Thorax: Scutum white and black pilose, brownish gray, with paler grayish pattern as follows: Laterally on humerus, entirely on notopleuron and supralar callus, and in form of 3 slender lines anteriorly, with submedial ones broader, pair of submedial spots at ends of transverse suture and another pair on hind margin of scutum in front of scutellum. Scutellum gray, white and black pilose. Pleuron gray, long white pilose. Halter white, with partially dark knob. Squamae with upper lobe brownish, lower lobe white. Wing pale brown with grayish-white markings in typical *Haematopota* pattern except as follows: No subapical band in marginal cell, 1 subapical band in 1st submarginal cell, usually with spots at bases of furcation and 2nd and 3rd posterior cells, all bands narrow and broken up. Legs: Coxae very pale gray, pale grayish-white pollinose, white pilose; trochanters yellowish brown, sparsely pollinose, white pilose; femora

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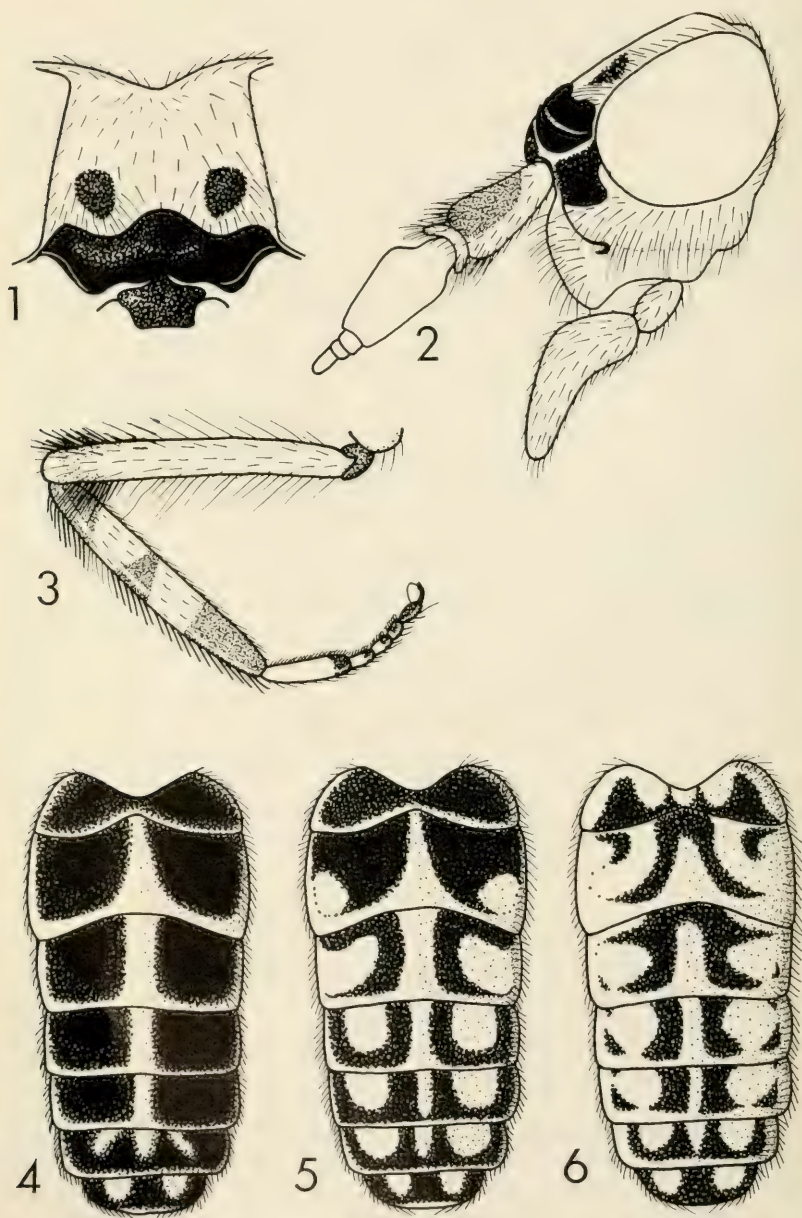


Fig. 1-3, 5. *Haematopota stonei*. 1, front. 2, head. 3, hind leg. 5, abdomen.
Fig. 4. *H. assamensis*, abdomen. Fig. 6, *H. crossi*, abdomen.

pale yellow except rarely brownish subapically, pale grayish pollinose, largely long white pilose, black pilose on apical $\frac{1}{4}$, with hind femoral hairs long and forming subapical tufts; fore tibia slightly swollen, about as wide as femur, with basal $\frac{1}{3}$ pale yellowish white, with apical $\frac{2}{3}$ brownish, sparsely light grayish pollinose, black pilose except for subbasal band of white hairs; middle tibia pale yellowish brown, except for 2 submedial yellow bands, sparsely light grayish pollinose, black pilose on dark areas, white on yellow bands; hind tibia slightly swollen, slightly wider than femur, with fringe of long hairs on dorsal margin, pale yellowish brown, except for 2 submedial yellow bands, long black pilose except for subbasal band of white hairs; front tarsus black, black pilose; middle and hind tarsi yellow on basal $\frac{2}{3}$ of basitarsi and narrowly on bases of 2nd through 4th tarsomeres, rest of tarsi brown, black pilose.

Abdomen: Dorsum mainly appressed black pilose, white pilose on 1st, basal $\frac{1}{2}$ of 2nd and sides of all terga, dark brownish gray except pale gray as follows: On sides and apical margins of all terga, in form of mid-dorsal stripe on all terga and paired sublateral spots always on 4th through 7th terga and frequently on 2nd and 3rd terga. Venter pale gray, except more brownish on 7th sternum, white pilose except with stiff black hairs on 7th sternum.

Holotype, ♀, Chitawan, NEPAL, 30 March 1974, J. C. Seidensticker, deposited in U. S. National Museum. Paratypes, 19 ♀♀, same data as holotype, deposited in California Academy of Sciences, Collection of C. B. Philip, Canadian National Collection, and U. S. National Museum.

Variations: The type series is fairly uniform in respect to the taxonomic characters used here and in Stone and Philip (1974). In a few specimens: 1) the mid frontal spot is present but very indistinct; 2) the gray pollinose median stripe on the scutum is complete, reaching the scutellum; 3) the gray pollinose crescentic prescutellar spots are complete and quite distinct; 4) the pale spot at the base of the furcation of vein R 4 + 5 is absent; 5) the gray pollinose spots on the 2nd tergum are present but weak; and 6) the gray pollinose spots on the 3rd tergum are indistinct. Three additional specimens were collected along with the type series. Two of these are undoubtedly representatives of another new species, similar to *stonei* but smaller (body length, 8.1–10.4 mm; wing length, 7.5–10.2 mm), much paler and more brownish in color, with a yellow and medially rugose frontal callus, and a much longer and narrower 1st antennal segment. The poor condition of these specimens prevents their description. The third specimen may also represent a new species, although, except for its overall pale coloration and pale scutellum, it agrees well with *stonei*.

Habitat: "These flies first appeared near the end of March (1974), when the stifling hot season began in this region of the Nepal terai. They did not seem to occur in riverine forest or in the tall-grass areas (3 mm in height) but they were numerous at the interface of the tall grass and Sal (*Shorea robusta*) dominated forest which covers the hills. Surface water was available in the area where they were col-

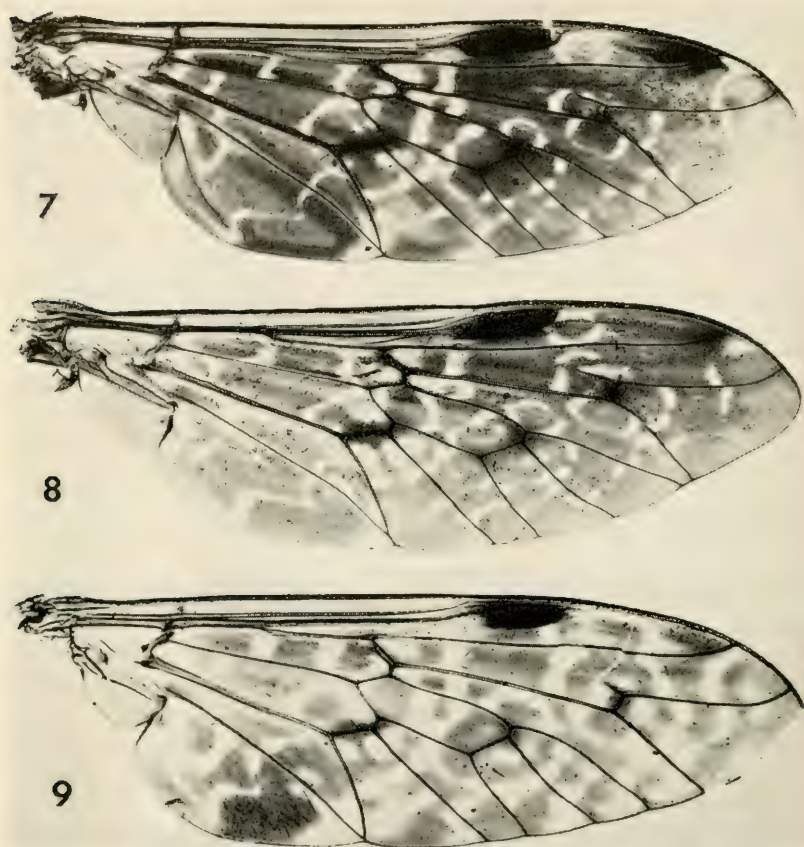


Fig. 7-9. Wings of *Haematopota* species. 7, *assamensis*. 8, *stonei*. 9, *crossi*.

lected even through the hot season. These flies were biting the ears of our domestic elephant, a species no longer present in the local wild fauna, but did not particularly bother the driver or myself." (Seidensticker, in litt.).

Haematopota stonei is closely related to both *crossi* Stone & Philip and *assamensis* Ricardo; *crossi* is smaller, somewhat petite, and much paler in color, whereas both *assamensis* and *stonei* are distinctly larger, more robust, and darker in color, with *assamensis* the darkest of the three (for precise measurements, see above and Stone and Philip, 1974). The principal differences between these species are listed in the following modification to Stone and Philip's key to the Oriental species of *Haematopotini*.

It is with great pleasure that I name this species after Dr. Alan Stone, who needs no introduction to dipterists as his work clearly speaks for him.

Modification to the Key to the Oriental Species of *Haematopotini*
(Stone & Philip, 1974)

- 1.-22. no change.
23. Squamae all white; frontal callus sharply attenuate laterally, broadly separated from eyes, yellowish brown (Stone & Philip, 1974:213, fig. 16); abdomen with large sublateral gray spots on all terga (fig. 6); notopleuron almost completely white pilose; wing with broad apical and posterior markings, 1 subapical band in marginal cell, 2 subapical bands in 1st submarginal cell, pale spots at bases of furcation, 2nd and 3rd posterior cells (fig. 9) (India (Punjab), Nepal) *crossi* Stone & Philip
- Squamae with upper lobe (alar) brownish, with lower lobe (thoracic) white; frontal callus not sharply attenuate laterally, touching or very narrowly separated from eyes, usually brownish black (fig. 1); abdomen usually with distinct large sublateral gray spots on 3rd through 7th terga, rarely with such spots on all terga, always with such spots on apical 4 terga (fig. 5); notopleuron largely black pilose; wing with narrow, broken apical and posterior markings, without subapical band in marginal cell, only 1 subapical band in 1st submarginal cell, usually with pale spots at bases of furcation, 2nd, and 3rd posterior cells (fig. 8) (Nepal) *stonei* Thompson, new species
- Squamae all light brown; frontal callus not sharply attenuate laterally, narrowly touching eyes, usually black (Stone & Philip, 1974:212, fig. 17); abdomen with only small sublateral gray spots on 6th and 7th terga (fig. 4); notopleuron largely black pilose; wing with narrow broken apical and posterior markings, without subapical band in marginal cell, only 1 subapical band in 1st submarginal cell, without pale spots at bases of furcation, 2nd, and 3rd posterior cells (fig. 7) (India (Assam), Thailand, Vietnam) *assamensis* Ricardo
- 24.-41. no change.
42. Hind femur pale on basal $\frac{3}{4}$ or more; hind margin of scutum usually with transverse pair of strong gray crescentic spots 43
- Hind femur dark brown to black on basal $\frac{3}{4}$ or more; hind margin of scutum without such markings 45
43. Scutellum rather distinctly bicolored, base pale 44
- Scutellum unicolorous or distal part paler than basal part 23
- 44.-180. no change.

I thank Dr. John C. Seidensticker, National Zoological Park, Smithsonian Institution, Washington, D. C., not only for collecting the *Haematopota stonei* material and donating it to the U. S. National Museum, but also for his valuable notes on its ecology. I also thank Drs. Alan Stone and Cornelius Philip for their comments on the status and relationships of this species. The fieldwork in Nepal was supported by grants from the World Wildlife Fund (U. S. Appeal) while Dr. Seidensticker was the principal investigator of the Smithsonian's Nepal Tiger Ecology Project.

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NOTE

**MACROCHELES INSIGNITUS BERLESE (ACARINA:
MACROCHELIDAE) PHORETIC ON NILOBEZZIA SCHWARZI
(COQUILLETT) (DIPTERA: CERATOPOGONIDAE)¹**

Most records of mites associated with biting midges have involved larval mites. Recently Grogan and Navai (1975, Proc. Entomol. Soc. Wash. 77:214-215) reported adult phytoseiid mites, *Amblyseius* sp. on *Culicoides schultzei* Enderlein. This was apparently the first record of an adult mite on a ceratopogonid as well as the first record for the order Parasitiformes on this fly family.

On 4 July 1975 W. E. Steiner collected some small insects attracted to lights at Wittman, Talbot Co., Maryland. An examination of the ceratopogonids collected revealed a female *Nilobezzia schwarzi* (Coquillett) with an unusually large mite attached to its abdomen. These were preserved in 70% ETOH and sent to P. H. Vercammen-Grandjean for identification, who forwarded them to G. W. Krantz. The mite was identified by Krantz as an adult *Macrocheles insignitus* Berlese, a predaceous species often phoretic on houseflies (Krantz, 1975, personal communication). This is apparently the first record of this mite family (Macrochelidae) phoretic on ceratopogonids, and the second record of the order Parasitiformes on these flies. The mite is deposited in the acarology collection of the National Museum of Natural History (USNM).

I would like to thank Gerald W. Krantz and Paul H. Vercammen-Grandjean for identification of the mite, and Warren E. Steiner for the specimens.

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¹Contribution no. 5243, Scientific Article no. A2251 of the Maryland Agricultural Experiment Station, Department of Entomology.

DESCRIPTION OF THE FEMALE OF *PSYCHODOPYGUS AYROZAI*
(BARRETTO AND COUTINHO) (DIPTERA: PHLEBOTOMINAE)

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ABSTRACT—Study of the allotype female of *Psychodopygus ayrozai* showed it belongs to *P. guyanensis*. The true female of *P. ayrozai* is identified and described mainly on the basis of collection data.

The female of *Psychodopygus ayrozai* (Barretto and Coutinho, 1940), was described by Barretto and Coutinho (1943) from a mating couple collected at Una, São Paulo State, Brazil, during May, 1941. This allotype was separated from the male and placed on a slide by itself. The slide was formerly in the School of Medicine Collection (no. 698) and was later removed to the School of Public Health (SPH) where it was kept on record as no. E-2237.

Phlebotominae pools collected by us in Sitio Sambura, Pedro de Toledo County, São Paulo State, Brazil (June 1973 to May 1974) consisted of *P. ayrozai* males and a number of females which did not agree with the original description and allotype of that species. Coutinho (1939) identified 5 specimens collected in Amazonas State, Brazil, as females of *P. davisii* (Root, 1934) and two of these specimens are preserved in the SPH collections (nos. 1681 and 1862) (Forattini, Rabello and Cotrim, 1971). These females are identical to the one collected by us in association with male *P. ayrozai* and they do not agree with a more recent description of the female of *P. davisii* (Martins, Falcao and Silva, 1973). In view of the above data we conclude that the real female of *ayrozai* is the one described and figured by Coutinho (1939) as *P. davisii*. From restudy of the allotype of *P. ayrozai* we conclude it is very similar to *P. guyanensis* (Floch and Abonnenc, 1941). Our conclusions are supported by two other circumstances: 1) several collections made at different places contained males of *ayrozai* accompanied by the same females as collected at Sitio Sambura; and 2) at Porto Raso, Miracatu County, São Paulo State, Brazil (April 1972) 18 males of *guyanensis* were collected with 37 females indistinguishable from the allotype of *ayrozai* (E-2237). So it seems to us quite reliable to establish these female associations on the basis of the collecting data and the study of collection material.

Psychodopygus ayrozai (Barretto and Coutinho), 1940

Flebotomus davisii of Coutinho, 1939: 182–183 (misidentification, not *Phlebotomus davisii* Root, 1934).

Female (fig. 1): Mesonotum and scutellum infuscated, upper region of pleura contrasting with inferior portion, where pigmentation is lacking. Palpal formula 1.4.5.2.3 or (1.4).5.(2.3) with terminal segment shorter than segment III. Wing with R_2 longer than R_{2+3} and this one longer than R_{2+3+4} , wing ratio nearly 2.0; delta positive almost as long as $\frac{1}{4}$ of R_2 . Ascoids simple, exceeding a little IV segment; III antennal segment shorter than epipharynx with ratio A III/E nearly 0.5. Cibarium with 4-6 triangular, median, bent, horizontal teeth, and with many vertical teeth stout and irregularly ordered; pigmented area present, clear and triangular in shape; chitinized arc absent. Spermathecae showing nitid annulations with 9-10 imbricated rings; individual ducts shorter than bodies; common duct 2.5-3.0 times longer than individual duct and body as a whole, striated proximally and smooth distally, with transition between these regions appearing a little more chitinized and straight.

Remarks: *Psychodopygus ayrozai* females can be distinguished from those of *guyanensis* by the following morphological characters:

	<i>P. ayrozai</i>	<i>P. guyanensis</i>
Cibarium	—4-6 horizontal teeth medianally bent. —Vertical teeth irregularly ordered, with largest ones medially placed.	—4 triangular horizontal teeth. —Vertical teeth with largest ones placed medially but arranged in 2 longitudinal lines, and smaller ordered along transverse line.
Thorax	—Mesonotum and scutellum infuscated, contrasting with pleurae and coxae.	—Mesonotum strongly infuscated, contrasting with scutellum, pleurae and coxae.
Spermathecae	—Individual duct shorter than spermatheca body. —Common duct only partially striated, limited to proximal region.	—Individual duct much longer than spermatheca body. —Common duct striated along all length.

Material examined: Brazil. SÃO PAULO STATE. Alecrim, CBA, Miracatu, April 1972, 5 ♀♀ 1 ♂. Porto Raso, CBA, Miracatu, April 1972, 1 ♀. Sítio Itanambuca, Ubatuba, June 1972, 1 ♀. Sítio Samburá, Pedro de Toledo, June 1973 to May 1974, 6 ♀♀ 5 ♂♂. Bairro Araçatuba, Pedro de Toledo, February to May 1974, 13 ♀♀. Sítio Ubaldo, Pedro de Toledo, April 1974, 1 ♀. AMAZONAS STATE, BRAZIL: Rio Paruáry, Manacapuru, 1937, 2 ♀♀ (specimens no. 1681 and 1682 det. as *P. davisi*, SPH collections). Colombia: Antioquia, May 1970, 1 ♀, 2 ♂♂.

Psychodopygus guyanensis (Floch and Abonnenc, 1941)

Phlebotomus ayrozai of Barretto and Coutinho, 1943: 183 (misidentification, not *Phlebotomus ayrozai* Barretto and Coutinho, 1941).

Material examined: Brazil. SÃO PAULO STATE. Una, May 1941, 1 ♀ (specimen no. E-2237, det. as allotype of *P. ayrozai*, SPH collections). Guaratuba, Santos, March 1972, 1 ♀. Porto Raso, CBA, Miracatu, April 1972, 37 ♀♀ 18

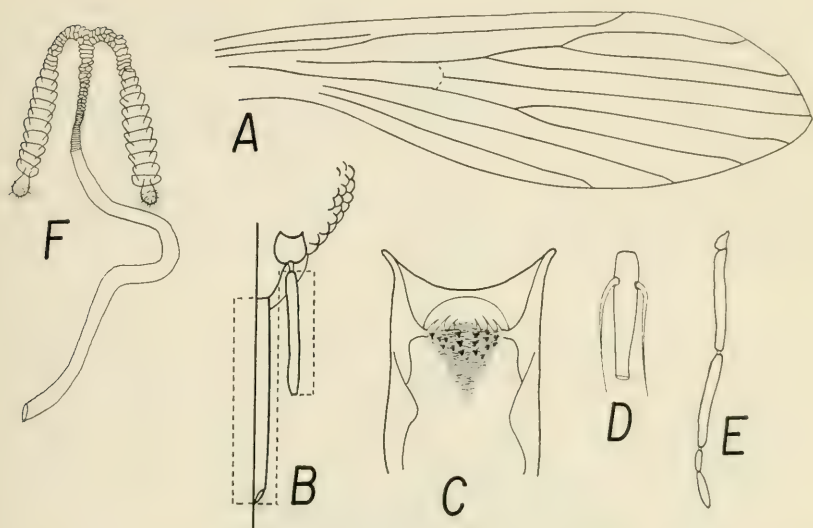


Fig. 1, *Psychodopygus ayrozai*. A, wing. B, epipharynx and first antennal segment. C, cibarium. D, antennal segment IV and ascoids. E, palp. F, spermathecae.

♂♂. Sítio Itamambuca, Ubatuba, April 1972, 1 ♀. AMAPA TERRITORY, BRAZIL: Serra do Navio, Macapa, April 1971, 1 ♀.

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NEW NORTH AMERICAN TABANIDAE (DIPTERA). XXIII.
ADDITIONAL NEW DIACHLORINI FROM MEXICO

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ABSTRACT—Described as new species in tabanid Tribe Diachlorini from Chiapas, Mexico, are females of *Stypommisa* **U-nigrum**, *Styp. apaches*, and *Stenotabanus mexicanus*. *Stypommisa stonei* has been the only *Stypommisa* previously so assigned, also from Chiapas.

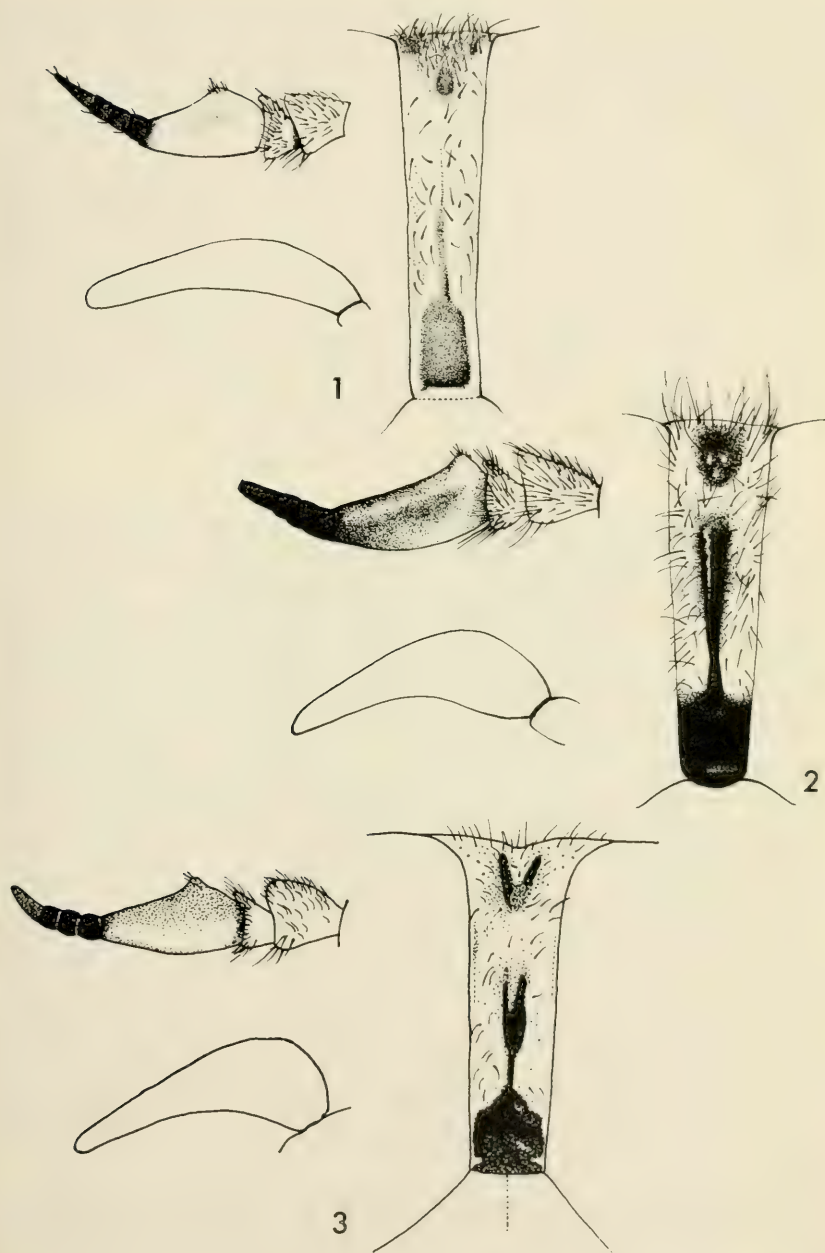
Another *Stenotabanus* and two new *Stypommisa* species are here added to the five diachlorine Tabanidae from Mexico, described in the previous paper in this series (Philip, 1976). Heretofore, *Stypommisa stonei* (Philip) was the only species to be assigned to the genus in Mexico. It is appropriate, in this commemorative issue dedicated to Dr. Stone, to augment information of the genus and a related species in that fauna. Typical neotropical species assigned to the above two genera are readily separable, but occasional species show intergradation in certain characters that make generic assignment very subjective (see Fairchild, 1969), as in one species described below, and in *Styp. captioptera* (Kröber), recently transferred from *Stenotabanus* by Fairchild who had identified a Chiapas female as syn. *Sten. xenium* Fairchild. *Stypommisa* thus only just crosses into southern Mexico from the neotropics to the south.

Stypommisa *U-nigrum* Philip, new species
fig. 1

A medium-sized, rather slender brownish species with yellow-banded abdominal incisures but no triangles, prominently spotted wings, pallid scutellum in front of which is a wide dark U-shaped scutal marking, and 2 hind pairs of legs reddish.

Holotype ♀, 12.5 mm. Eyes bare, unbanded (relaxed). Frons brown pollinose, narrow, index 1/5.8, nearly parallel-sided, patch of coarse black bristles at vertex above small but distinct tubercle with 3 compact vestigial ocelli; callosity dark brown, taller than broad, tapered abruptly above into slender keel, separated narrowly from eye margins and from yellow pollinose subcallus below, the usual suture across top of latter indistinct. Face and cheeks gray pollinose with mixed gray and some black hairs. Two basal antennal segments brown with black hairs, scape a little longer than tall, plate red with low dorso-basal angle, subequal in length to sharply black style. Palpi dusky gray, black-haired, long and slender but blunt, nearly as long as unsheathed stylets.

Thorax pale pollinose and mostly pale pilose, accentuated in the prescutellar-scutellar area behind a peculiar brown, black-haired, wide U-shaped marking and a narrow midline forward from it. Fore legs dark brown, black-haired, tibiae reddish with pale hairs in basal thirds. Two hind pairs of legs reddish with mostly pale hairs, more black on dorsums of femora and in hind tibial



Figs. 1-3, Frons, antenna and palpus. 1, *Stypommisa U-nigrum*. 2, *Stypommisa apaches*. 3, *Stenotabanus mexicanus*.

fringes. Wing with unusual pattern of whitish membrane around prominent clouds, the apical and hind margins smoky, accentuated in certain lights. Spur veins as long as stems. Halteres pale brown. Basicostas with a few setulae.

Abdomen reddish brown, darker caudally, black-haired across bases of terga, the incisures broadly reddish yellow (as much as $\frac{1}{2}$ of 3 and 4) with yellow hairs; venter reddish, entirely yellow-haired.

Holotype and 2 paratype ♀♀, Mexico: Chiapas, Montebello Nat'l Park. 17.v.69. H. J. Teskey. In CNC (Canadian National Collection) No. 12925; one in CAS (California Academy of Sciences). Wear in the latter has reduced the prominence of the incisural bands and the scutal marking. This U-shaped marking in front of the pallid scutellum and the peculiar whitish wing membranes surrounding unusually heavy clouds with smoky apical and hind margins distinguish this from related species. The banded abdomen is unusual in the genus.

Stypommisa apaches Philip, new species
fig. 2

A reddish brown, slender (hence the name from Gr.) fly with dark, unlined notum, bicolored legs, wings tinted and with distinct clouds on cross veins and forks, bare basicostas, and elongate, red-brown antennal plates.

Holotype ♀, 13.5 mm. Eyes bare, purple with 2 green bands (relaxed). Frons narrow, gently convergent below, index 1/5.5, buff-gray pollinose with darker evanescent patch across middle; scattered black hairs and coarse patch at vertex surrounding low, bare black tubercle with 3 vestigial ocelli; callosity black filling lower frons which is somewhat rounded below, and extending into a heavy median callus to above the upper $\frac{1}{3}$. Subcallus and upper parafacials pale yellow pollinose, latter with a few pale yellow and black hairs. Remainder of face and cheeks whitish pollinose and pilose. Antennae with 2 basal segments reddish with black hairs, not swollen; plates reddish with brown lateral streaks, nearly twice as long as tall with distinct, subrectangulate dorso-basal tooth; style sharply black and over $\frac{1}{2}$ length of plate. Palpi pallid, rather long and blunt, a little thickened basally with pale hairs becoming mostly black distally.

Scutum and scutellum dark brownish black with some gray pollen but no lines anteriorly; covered with sparse yellow and some short black hairs; pre-alar tubercles dull reddish. Pleura and coxae pale pollinose and pilose. Fore femora, tibiae and tarsi black with concolorous hairs, basal halves of tibiae reddish with pale yellow hairs. Two hind pairs of femora brownish black, mostly yellow haired with some black hairs dorsally; tibiae reddish with pale yellow hairs including hind tibial fringes, darkened apically and on tarsi. Wings smoky, hardly accentuated apically, costal cells pale yellow; clouds on cross veins and forks distinct but not as large as in *S. U-nigrum*; spur veins as long as stems. Halteres brown.

Abdomen reddish basally grading to black on last 3 segments above and below, mostly black-haired dorsally, pale yellow on venter and narrowly across dorsal incisures and narrow lateral margins, with narrow middorsal pale triangles not crossing terga; a small diffuse dark integumental spot in middle anteriorly of tergum 2.

Holotype ♀, Mexico: Chiapas, 20 mi. N Bochil, 6500 ft. 9-10.vi.69. W. R. M. Mason. In CNC, No. 12926. One paratype ♀ same, but 5 mi. NE San Cristobal. 21.v.69. B. V. Peterson. In CAS. The latter is a little shorter and the midfrontal keel not as heavy, more slender.

Generic assignment in this intermediate species is based on frontal characters and heavier wing clouds as more relevant than the double-banded eyes and completely bare basicostas. Among other *Stypomisa*, *S. lerida* (Fchld.) and *S. pequiensis* (Fchld.), which are known as far north as Costa Rica, and *S. captiroptera* (Kröb.) lack wing clouds, have callosities not filling lower fronts, and eyes with one or no bands in life. *Sten. chiapasensis* Fchld. has moderate wing clouds, but differs in complete though serrated, mid-abdominal stripe, shorter orange antennal plates, hind legs unicolorous, and a third eye stripe.

Stenotabanus mexicanus Philip, new species
fig. 3

A medium-sized, brownish-red species with dark, unlined notum and scutellum, reduced mid-abdominal gray triangles and obscure sublateral spots on terga 2 to 4, hyaline wings with faintly tinted costal cells, and mostly reddish legs.

Holotype ♀, 15 mm. Eyes bare, purple with 2 green bands (relaxed). Frons gray pollinose, moderately narrow and gently convergent below, index 1/4.2, a few black hairs at somewhat depressed vertex, no tubercle but 2 bare, dark diagonal streaks and suggestions of an anterior vestigial ocellus. Callosity large, black grading to dark brown below, nearly touching eyes with a peculiar small lateral notch at each lower corner, rounded above and connected to a median ridge which reaches just over halfway to vertex. Subcallus, face and cheeks gray pollinose, and sparsely whitish pilose below. Antenna dark reddish with black hairs on basal 2 segments, plate more brownish dorsally with low rectangulate basal angle and half again longer than tall, or than black style, apical annulus pallid. Palpi pale yellow, moderately enlarged at knees, mostly black-haired. Notum and scutellum blackish, sparsely gray pollinose and with scattered short yellow and black hairs. Pleura and coxae pale gray pollinose and pilose. Legs mostly reddish with pale hairs, but black ones give fore and hind femora a darker appearance, fore tibiae pale-haired on basal 2/3, hind tibial fringes pale-haired basally with some black hairs distally. Spur veins longer than stems. Basicostas bare. Halteres brown.

Abdomen predominantly reddish brown, mostly black-haired above, and reddish with yellow hairs ventrally, the last segment black; dorsal incisures narrowly yellow-haired expanding laterally and mesally into low gray triangles decreasing in size from terga 2 to 4, and an obscure one on 5, that on 2 nearly equilateral but not crossing tergum; vague red, sublateral spots on some terga.

Holotype ♀, Mexico: Chiapas, Oroyo Agua Caliente, 15 mi. S La Laguna, 10.vii.72. Lattin Coll. In coll. L. L. Pechuman, Cornell University.

Paratype ♀, same including collector, but Oroyoala Rana, 10 mi. SE Vergel (La Laguna), 9.viii.52. In coll. of author. Slight differ-

ences of this in frontal characters consist of no spots in sparsely pollinose, mid-vertex, no small notches in lower corners where callosity barely touches eyes, and mid-carina slender to upper $\frac{1}{3}$ of frons. Basicostas likewise entirely nonsetulose.

The abdominal pattern has some superficial semblance to the obscure sublateral spots seen in northern *Sten. flavidus* (Hine) but here the median triangles do not cross any terga and the frons is wider and callosity larger than in either *S. flavidus* or *Styp. captirop-tera* (Kröb.) which has wing shadows apicocostally and some setulae on basicostas. Until females are discovered that can confidently be assigned to the enigmatic, poorly described *Tabanus obesus* Bigot from "Mexique," possible relationships to this group will remain uncertain. The brownish type male in the British Museum was found now to be headless, but its bare basicostas and obscure abdominal triangles will not confuse with *S. mexicanus* n. sp. because, though the wings are similar, they lack spur veins at the forks.

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AEDES (MACLEAYA) STONEORUM, A NEW SPECIES FROM
QUEENSLAND (DIPTERA: CULICIDAE)

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ABSTRACT—*Aedes stoneorum*, from Moa Island, Torres Strait, is described and compared with other species of the subgenus *Macleaya*.

Two species are currently recognised in the subgenus *Macleaya* Theobald. I have pleasure in naming a third species, described here, in honour of Alan Stone and his wife, Louise, in appreciation of their many kindnesses to myself and other dipterists visiting Washington, and in acknowledgement of Alan's great personal contribution to culicid taxonomy and his generous help to others working in this field.

Aedes (Macleaya) stoneorum Marks, new species
fig. 1-7

Holotype female: Length (in mm): wing 2.4; labium 1.65; maxillary palpus 0.5; antenna 1.8; abdomen 2.0; foreleg—femur 1.3, tibia 1.45, tarsomeres 0.9, 0.4, 0.3, 0.2, 0.2; midleg—femur 1.4, tibia 1.7, tarsomeres 1.25, 0.6 (3-5 missing); hindleg—femur 1.4, tibia 1.7, tarsomeres 1.5, 0.95, 0.7, 0.5, 0.3.

Head. Integument dark brown. Decumbent scales of vertex mainly broad, black, with white scaling as follows: Median stripe of narrow scales (includes 2 broad anteriorly) not reaching ocular margin, widening at occiput to link with dorsolateral stripes of broad scales which meet ocular line of small broad scales; patch of broad scales laterally and small patch ventrolaterally, both on ocular margin. Erect scales short, black, on occiput (possibly denuded from vertex). Ocular setae strong, black. Labium black scaled, labella dark. Maxillary palpus black scaled with dorsal patch of white scales on apical 0.2, overhanging tip; setae black. Eyes contiguous, large, dark. Clypeus shining dark brown. Antenna—pedicel shining dark brown, mesal patch of small broad white scales, dark setae dorsally; flagellomeres subequal, dark brown (first paler at base, without scales), verticillate setae black.

Thorax. Integument very dark brown. Scutum moderately densely clothed with narrow, bronzy-black scales, with white scale pattern as follows: narrow scales in midline anteriorly and forming almost continuous line round margin to scutal angle, continuing sublaterally above supraalar setae but ending before wing root; mesal to anterior dorsocentral setae, a few narrow scales in discontinuous line not reaching anterior margin (middle $\frac{1}{3}$ of scutum denuded dorsally); patch of narrow scales among supraalar setae and some lateral to posterior dorsocentral setae; line of scales surrounding prescutellar bare space, mainly narrow but posteriorly some moderately broad. Scutellar scales all white, on mid lobe broad, on lateral lobes moderately broad. Most dorsal scutal setae lost; alveoli of strong acrostichal, anterior and posterior dorsocentral; scutal fossal strong, black; numerous long, strong, black supraalar, with group of shorter, black, blunt-tipped dorsal to preala. Scutellar setae lost, alveoli of 5 strong median and 7 lateral.

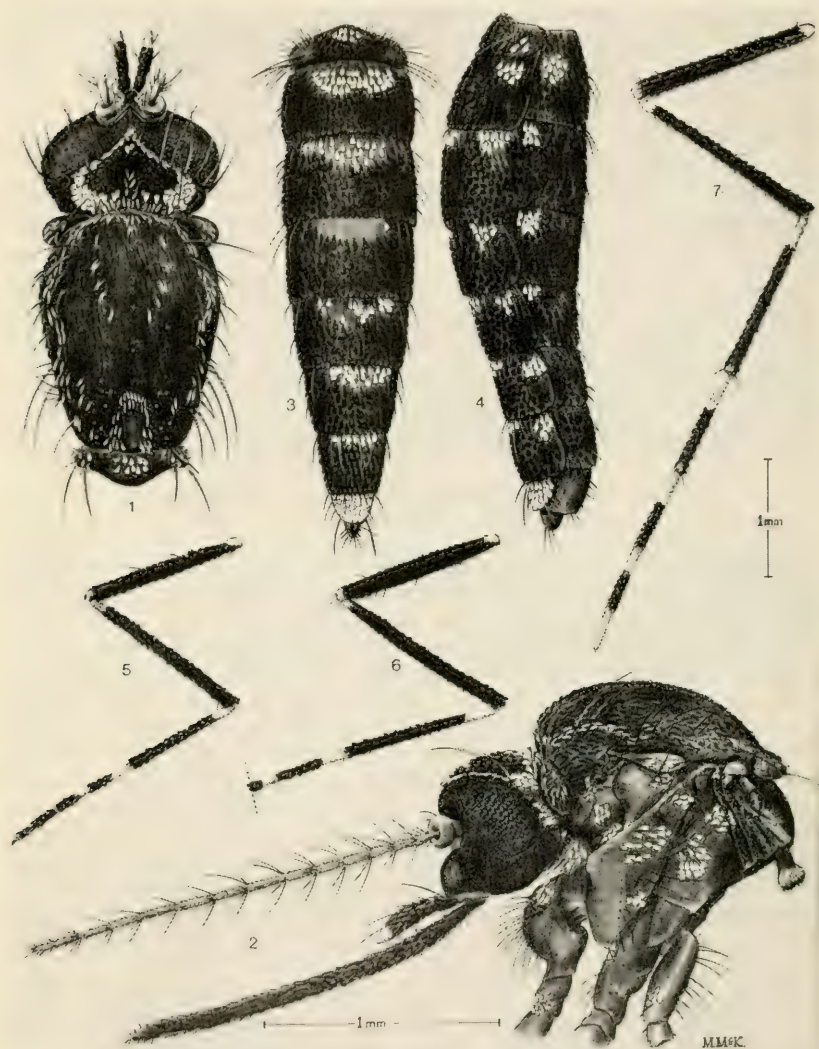


Fig. 1-7, *Aedes (Macleaya) stoneorum*, holotype female. 1, head, thorax, dorsal aspect. 2, head, thorax, lateral aspect. 3, abdomen, dorsal aspect. 4, abdomen, lateral aspect. 5, foreleg, 6, midleg, 7, hindleg, anterior aspect.

Mesopostnotum dark brown. Anteprenotal scales narrow, white; setae black. Postpronotal scales narrow, bronzy black, with patch of white below 2-3 strong black setae. Pleuron with patches of broad white scales as follows: On propleuron (some rather elongate); upper posterior angle of postspiracular area; subspiracular

area (an elongate patch of posterodorsally directed scales along mesepisternal margin, almost contiguous with small anterior patch of narrower, dorsally directed scales); mesepisternum (large upper patch, lower posterior patch); preala below setae; lower $1\frac{1}{2}$ of paratergite (small broad scales); mesepimeron (large anterior patch extending from 0.25 above lower margin and almost continuous with patch at base of upper mesepimeral setae). Pleural setae: 9–13 brown propleural; 3 postspiracular; about 10 dark and lighter brown prealar; mesepisternal—3 upper, row of about 5 strong brown posterior, short light and dark brown posterior and ventral to lower scale patch; 8 light brown upper, no lower mesepimeral.

Legs. Coxae black scaled with white patch; setae long, strong, very numerous on forecoxa. Trochanters with black and white scaling. Femora, tibiae and tarsi mainly black scaled, with white scaling as follows. Foreleg: Femur with narrow basal band incomplete ventrally, incomplete posterior streak on basal 0.6, and apicodorsal patch; tibia with very narrow basal band; tarsomeres 1–3 with basal bands, ratio of dorsal length of band to length of tarsomere respectively 0.2, 0.4, 0.3–0.4, bands ventrally narrower on 1 and 2, interrupted on 3. Midleg similar to fore, femur without posterior streak, bands on basal 0.17 tibia, 0.15 tarsomere 1, 0.3 tarsomere 2 (3–5 lost). Hindleg: Femur with basal and apical bands and, on basal 0.5, sparse anteroventral mottling and posterior streak; band on basal 0.17 tibia; tarsomeres 1–4 with basal bands, ratio of dorsal length of band to length of tarsomere respectively 0.2–0.25, 0.4, 0.4, 0.3, 1 and 2 with small anterodorsal apical patch, 5 all white. Numerous very short, stout setae on tibiae and first tarsomeres, tibiae also with longer strong setae about twice diameter of tibiae in length. Fore and hindposttarsus with unguis equal, simple (mid lost).

Wings. Black scaled with 2 small white patches, 1 at base of C and 1 on posterior margin of C proximal to humeral crossvein; no hairs on remigium; plume scales very elongate and dense; scales of alula and tertiary fringe scales dark, blunt-tipped. R_3 1.9 length of R_{2+3} ; M_2 0.7–0.8 length of M_{1+2} ; r-m twice its length distal to base of M_{3+4} ; base of Cell R_2 proximal to base of Cell M_1 . Halter pale, capitellum white scaled.

Abdomen. Terga black scaled with median basal white patches, small on I, broad and about 0.3 length of tergum on II–VI (IV denuded), 0.2 on VII; laterotergite with white scales; basal rounded white patches, sublateral on II–V, lateral on VI and VII; VIII white scaled. Sterna black scaled with lateral basal white patches, large and reaching apical margin on II, about 0.3 length of sternum on III–V, VII (not visible on VI); a few median basal white scales on III, IV, VI; sternum VIII large, bare of scales, posterior margin straight. Cerci short, broad, bare of scales.

Holotype, ♀, Moa (Banks) Island, north Queensland, biting in bush, 1930–2100 hrs, 7.v.1953, E. N. Marks et al., in University of Queensland Insect Collection. The holotype is slightly denuded, as indicated above, and lacks left midtarsomeres 3 (part), 4, 5, right midtarsomeres 2 (part), 3–5, left hindtarsomeres 1 (part), 2–5, right hindtarsomere 5 (lost after it had been described and measured).

The subgenus *Macleaya*, with two species currently recognised from Australia and New Guinea, was last reviewed by Edwards (1932); its affinities with subgenus *Chaetocruomyia* Theobald were discussed by

Marks (1963, 1964). The type-species, *Aedes tremulus* Theobald, which has a wide distribution, was described from South Queensland (Theobald, 1903); Bancroft (1908) made it clear that the type-locality is Deception Bay. *Aedes littlechildi* (placed in subgenus *Macleaya* by Knight and Marks (1952) was described by Taylor (1933) from the Kokoda-Buna district of Papua; it also occurs in Queensland. Besides *Ae. stoneorum*, five additional species can be recognised in material gathered for a revision of the subgenus. The general habitus of all species is similar—small thick-set mosquitoes with many strong setae on thorax and legs; all have similar pleural scaling and setation, and hindtarsomere 5 and female tergum VIII entirely white scaled. Distinctive differences are found in the extent of pale scaling on head, scutum, legs and abdomen, and in the male genitalia. Larvae (where known) resemble the larva of *Ae. tremulus* (cf. Dobrotworsky, 1965). *Aedes tremulus* and *Ae. littlechildi* have a scutal pattern of linear pale scaling basically similar to that of *Ae. stoneorum*, but so variable in extent that it is doubtful whether apparent differences in detail between the three species will prove reliable. Both *Ae. tremulus* and *Ae. littlechildi* have dark scales laterally on mid lobe of scutellum, wings entirely dark scaled, and only small white patches at apex of hindfemur and base of hindtibia. *Aedes littlechildi* females have complete white bands on at least terga and sterna III–V; *Ae. tremulus* females have tergal pale scaling more variable, sterna II–V largely pale with black apicolateral patches. *Aedes stoneorum* is distinguished from all other known species of *Macleaya* by having a white patch on C adjacent to humeral cross-vein and a white basal band on hindtarsomere 4, which is entirely dark in other species. In his subgeneric diagnosis, Edwards (1932) described the female abdomen as having segment VIII small and almost hidden, but in blood-fed or gravid specimens the sternum is visible, usually also part of the tergum.

Moa (Banks) Island is one of the granitic western islands of Torres Strait. The collecting site was north of St. Paul's village (10°10'S, 142°20'E) near Bubu Creek, a permanent fresh stream, not far from its mangrove-fringed mouth. One female of *Ae. littlechildi* was taken in the same collection.

Larvae of all species of *Macleaya* for which breeding places are known have been found in water-holding cavities in trees or tree-stumps, usually in deep, narrow holes; *Ae. tremulus* also colonises artificial containers, including tires and rainwater tanks. Specimens of this subgenus have not been collected in tropical or subtropical rainforest.

I am grateful to the Australian Biological Resources Study Interim Council who provided a grant for illustrations, and to Margaret McKenzie for executing these.

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NOTE**NEW STATE RECORDS FOR SPECIES OF TRICORYNUS
(ANOBIIDAE: COLEOPTERA)**

Identifications I have made on specimens from various collections provide new state records for members of *Tricorynus* Waterhouse. These localities of collection are in addition to those listed in my revision of *Tricorynus* (1965, *Misc. Pub. Entomol. Soc. Amer.*, 4 (7): 285-368). The species and the new localities follow: *T. abnormis* White, St. George, Utah, Leeds, Utah, and Yuma, Arizona; *T. californicus californicus* White, 15 mi. S. of Hanksville, Utah, and 2 mi. E. Torrey, Utah; *T. carinatus* (Fall), Harrison Co., Mississippi; *T. castaneus* (Hamilton), Waukesha Co., Wisconsin; *T. consobrinus* (Fall), 13 and 8 mi. S. Hanksville, Utah; *T. dichrous* (Fall), Florence, South Carolina, and Harrison Co., Mississippi; *T. dispar* (Fall), Harrison Co., Mississippi; *T. gracilis* (Fall), Harrison Co., Mississippi; *T. nigritulus* (LeConte), Harrison Co., Mississippi; *T. productus* White, Martin, South Dakota; *T. pusillus* (LeConte), 13 mi. S. Hanksville, Utah; *T. rotundus* (White), Bradley Co., Arkansas; *T. ventralis* (LeConte), Harrison Co., Mississippi.

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GENITALIC SUBSTANTIATION OF FIRST RECORD IN THE NEW
WORLD OF A REPRESENTATIVE OF THE PECULIAR OLD WORLD
TABANID TRIBE RHINOMYZINI (DIPTERA: TABANIDAE)

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ABSTRACT—The genitalia of *Betrequia ocellata* from the Amazonas Basin substantiate assignment of this unusual tabanid fly to the tribe Rhinomyzini.

In 1970, Oldroyd described a "strange female horsefly" from the lower Amazon Basin in Brazil and considered it to be related to the Afro-Indian tribe Rhinomyzini, this being the first record of the tribe in the New World. He named the horsefly *Betrequia ocellata*, a new genus and a new species. The tribe Rhinomyzini has radiated widely in the Afro-Indian region and consists of bizarre forms which mostly breed in arboreal rot-holes. Oldroyd subsequently wrote that the original two specimens, now in the British Museum, were taken at different times by a lepidopterist, apparently in arboreal situations on a lower tributary of the Amazon near Pará, hence these flies have not been previously taken near the ground. If *B. ocellata* frequents the jungle canopy, it is interesting that no record has turned up in collections of biting insects in tree canopy studies, such as collections at jungle yellow fever stations (Fairchild, 1953). However, a third female was netted at ground level near Leticia, upper Colombian Amazonas, by Dr. Richard W. Merritt, now of Michigan State University (Philip, 1975). This specimen was loaned to us by Dr. Robert S. Lane of the State Health Department, Berkeley, California, and permission was granted to make a genitalic preparation.

A comparison is made with rhinomyzine genitalia of Old World species figured by Mackerras (1955) and Ovazza and Taufflieb (1954). They all agree on the characters that define the tribe: Caudal spermathecae are simple tubes without mushroomlike expansions, and terga IX and X are divided. The closest rhinomyzine genus treated by these authors is *Tabanocella* and, compared with our material (fig. 1), has the same sub pentagonal cerci, as well as similar structure of terga IX and X. Sternum VIII in *Tabanocella* is wider in the middle, not at the base as in *Betrequia*, but this, together with the convex base of the genital fork and little longer spermathecal ducts, we consider relates to differences at the generic level. The combs of the genital fork illustrated by Ovazza and Taufflieb (1954) show strong teeth

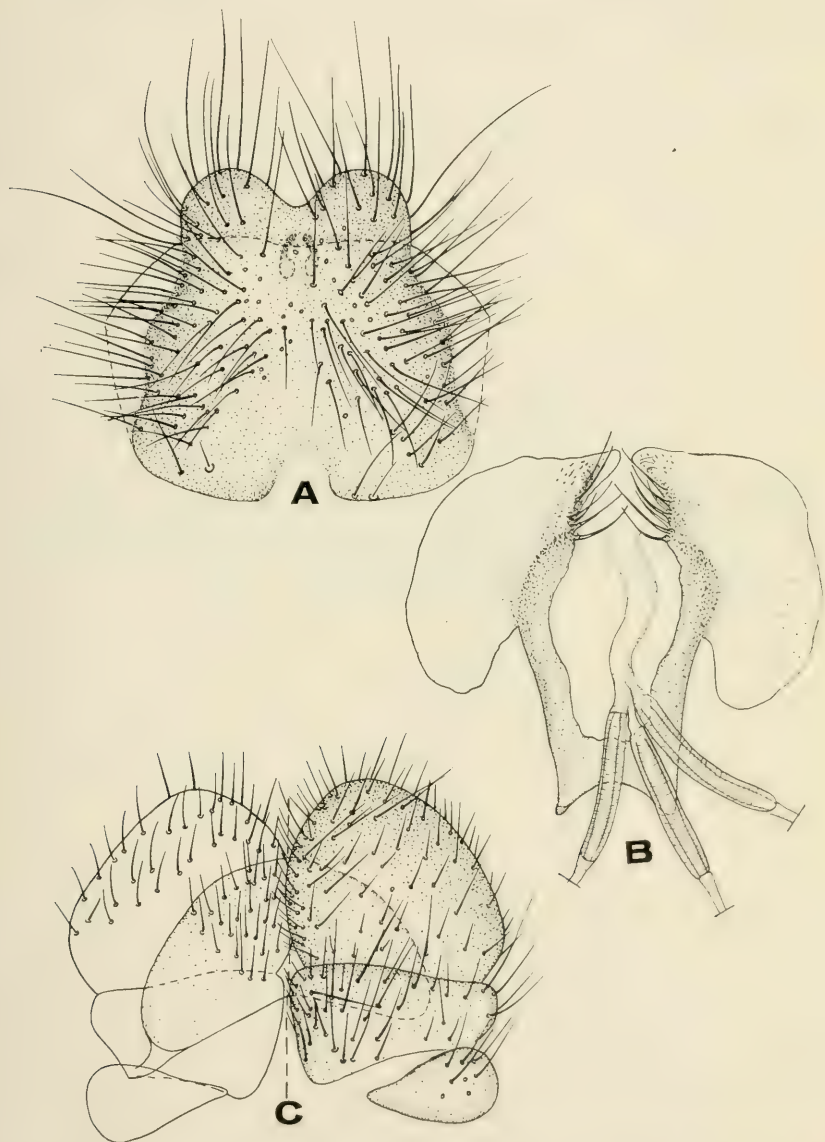


Fig. 1, Genitalia of *Betrequia ocellata*, female. A, eighth sternum and gonapophysis. B, genital fork with caudal spermathecal ducts. C, terga IX, X, cerci and hypoproct.

as in our preparation. We think that the genital structure, plus the bizarre body characters, support assignment of *Betrequia* to the Rhinomyzini in spite of the geographic disparity.

Oldroyd (1957) has pointed out that the haematophagous habits of adult females in the tribe are not universal, since some species lack piercing stylets. The condition of our specimen, which has a short proboscis with labella "closed like shells of a bivalve," could not be observed without dissection, and we were reluctant to further mutilate this unique fly.

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LABOSTIGMINA HIEROGLYPHICA (OLIVIER) AND ITS
CLOSEST RELATIVES IN EASTERN NORTH AMERICA
(DIPTERA: STRATIOMYIDAE)¹

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ABSTRACT—*Labostigmina stonei*, is described from Kentucky, and the species of the eastern United States most closely related to it and to *L. hieroglyphica* are discussed. *Labostigmina johnsoni* is reduced to subspecific status under *hieroglyphica*.

James and Steyskal (1952) referred seventeen Nearctic species to this genus and presented a key to their identification. James (1970) added an eighteenth species, *atrifacies*, removed as extralimital a previously recorded one, *viridis* (Bellardi), and replaced it by the now valid *snowi* (Hart), previously considered its junior synonym. The present paper describes an additional species and discusses the status of the most closely related forms. Bibliographic references are omitted since they may easily be obtained from the Nearctic Diptera catalog (James, 1965).

Five of the species listed in the catalog, namely, *hieroglyphica* (Olivier), *johnsoni* (Curran), *annamariae* (Brimley), *megantica* (Curran), and *defecta* James, form a closely related complex. I am dedicating the new species of this complex to my long-time friend, one-time associate, and highly respected co-worker in dipterous taxonomy, Dr. Alan Stone.

Labostigmina stonei James, new species

♀. Head mostly greenish yellow. Ocellar triangle, frons below transverse sulcus, and face except narrow ocular orbits black; orbits greenish yellow, in general narrower than in other species of this complex; face just above oral margin usually brownish yellow to yellowish green, color and extent of this area variable; oral margin black except sometimes partly brownish yellow to greenish yellow. Frons above transverse sulcus sometimes wholly greenish yellow but usually marked with black as follows: Median vitta extending from black area of lower frons as much as halfway to anterior ocellus and prominent but isolated crescentic spot extending from each eye margin toward ocellar triangle; sometimes band on vertex extending from ocellar triangle toward and even at times attaining eye margin; in holotype a small anterior extension of ocellar triangle area directed ventrad along median line. Head markings variable but those on

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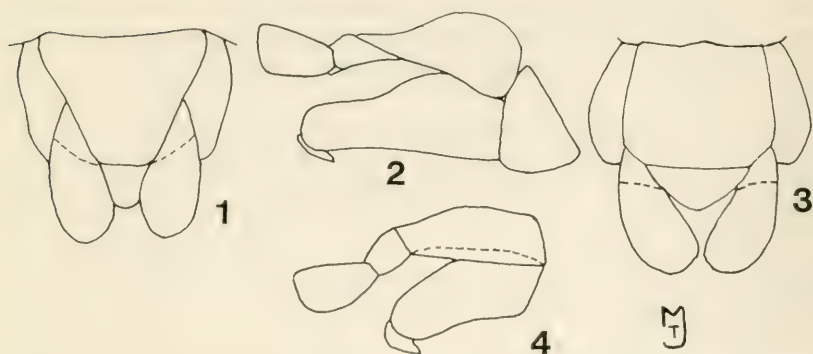


Fig. 1-4, *Labostigmina* spp., male genitalia. 1, *stonei*, dorsal view. 2, same, lateral view. 3, *hieroglyphica johnsoni*, dorsal view. 4, same, lateral view. All hairs omitted.

upper frons much less extensive than in the other species of this complex. Transverse sulcus close to plane of antennal insertion and poorly impressed. Pile of ocellar triangle and frons erect, black on ocellar triangle and most of frons, otherwise pale yellow; that of face and genae appressed to subappressed, pale yellow to yellowish white. Scape and at least base of pedicel yellow, rest of pedicel variable, brownish yellow to brownish black, flagellum brownish yellow to brownish black or reddish black, usually paler at base, becoming almost black toward apex but without a strong transition from the paler to the darker color. Antennal ratio 25:13:65 (width of head by comparison 200). Proboscis black.

Thorax mostly black; postalar callus, supra-alar margins, and scutellum except extreme base greenish yellow; humeri wholly black; broad upper parts of mesopleuron, of sternopleuron, and of pteropleuron greenish yellow. Mesopleuron with abundant but short suberect to erect yellow hairs overlying similarly abundant but short appressed ones; those of scutellum similar but tending toward brown at base; those of pleura appressed to subappressed and longer. Scutellar spines very small. Coxae and femora black, tibiae and tarsi yellow to reddish yellow, tending to brownish toward apices of tibiae and apical tarso-meres. Wing hyaline, strong veins brown. Halter almost black at base, becoming bright green on knob (or sometimes brownish yellow, apparently dependent upon state of preservation).

Abdomen mostly black dorsally; 2nd tergum broadly, 3rd to 5th narrowly, bordered laterally with greenish yellow, this color continuous medially on posterior margins for variable distance on terga 2 to 4 and on entire posterior margin of 5. Sterna greenish yellow with prominent black areas of variable extent, at maximum including most of 1, 2, 3, and 5, at minimum limited to lateral spots on 3 and 4 and a transverse band on 5. Pile of terga yellow and appressed to subappressed laterally, mostly short, erect and black on disc, pale and black hairs overlapping to an extent; pile of venter pale yellow.

Length, 9.2-10.5 mm, of holotype 10.0.

♂. Head wholly black. Pile of head much longer than in female, yellow to bright yellow. Thorax wholly black except scutellar spines which are brownish

yellow; pile long and bright yellow, erect mesonotal hairs about as long as combined scape and pedicel. Markings of terga more prominent than in the female, those of 3 and 4 broadly triangular; hairs black and yellow as in female but longer, sterna wholly yellow with yellow hairs. Genitalia mostly dark brown to brownish black; last tergum (fig. 1) a truncated triangle; basistyle (fig. 2) stouter and more strongly sclerotized than in other members of this complex, in lateral view humped anteriorly, mostly black but becoming reddish yellow toward apex. Length, 9.5–11.0 mm.

Holotype ♀, Evan Mill, Lexington, KY, 24-V-1945, L. H. Townsend; Washington State University type no. 355.

Paratypes: 2 ♀, same data; 6 ♀, Lexington, KY, 19-V-1951, 2-V-1952, 6-V-1954, 5-V-1957, Townsend; 1 ♂, same, 15-V-1954; 2 ♀, same but collector not given, 12-V-1957 and 29-V-1927 (1957?); 1 ♂, Garrett, KY, 1-V-1957; 1 ♀, Jessamine Co., KY, 12-V-1954; 1 ♀, Woodford Co., KY, 1-VI-1943, Ritcher & Townsend; 1 ♀, Paris, KY, 31-V-1963; 1 ♀, Stanford, KY, 10-5-1963.

In my key (James and Steyskal, 1952) females trace to *annamariae* or, if the darkening of the venter is slight, as in one paratype, possibly to *johnsoni*; the males available to me trace to *johnsoni*. The narrow lateral yellow margin of the second tergum will readily distinguish the females from *annamariae* and the black humerus, the partly blackened venter, and the more extensive black area of the face will separate them from *johnsoni*. The male genitalia (fig. 1, 2) differ from those of other members of this complex in being more strongly sclerotized, in having the basistyle stouter and more strongly developed and more convex basally, and in the truncated triangular, rather than subquadrate, last tergum.

Labostigmina micheneri James, based on a single male, is similar and, like *L. stonei*, has extensive black abdominal pile. In that species, however, the scape is shorter in relation to the pedicel (ratio, 1.25:1) and the flagellum is black on the last two flagellomeres in strong contrast to the pale color of the basal ones.

Labostigmina hieroglyphica hieroglyphica (Olivier)

Distribution: Atlantic states, Maine to Florida but particularly southern, extending westward at least to Arkansas and Louisiana.

Labostigmina hieroglyphica johnsoni (Curran), NEW STATUS

The best interpretation of this form, in the light of our present knowledge, is as an essentially western subspecies of *hieroglyphica*. It is distinguishable from the typical form by its largely yellow antenna, including the entire scape, pedicel, and at least base of flagellum; in contrast the antenna of *hieroglyphica* is wholly black, the scape and pedicel being glossy. The male genitalia (fig. 3, 4) of the

two subspecies appear identical. Contrary to my previous statement (James and Steyskal, 1952:411) some intergradation does occur. The distributional pattern, though essentially that of a subspecific form of *hieroglyphica*, is somewhat puzzling, indicating that possibly hybridization may occur. A male, Hope, Arkansas, 22-IV-1965, H. R. Dodge, bears the same data as two females that pass for typical *hieroglyphica*, and I have males and females of both forms from Kenesaw Mt., Georgia. Yet typical *hieroglyphica* strongly predominates over a much wider area east of the Mississippi, whereas the reverse is true west of that river. Distribution of *johnsoni*: Texas to Kansas, Tennessee, and Louisiana, scantily represented eastward to Georgia and the District of Columbia.

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QUINQUEFASCIATUS OR FATIGANS FOR THE TROPICAL (SOUTHERN) HOUSE MOSQUITO (DIPTERA: CULICIDAE)

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ABSTRACT—Towards an objective resolution of the controversy regarding the use of *quinquefasciatus* or *fatigans* as the specific-group name for the Tropical (Southern) House Mosquito, initiated by Alan Stone in 1957, an analysis is made of the type-material at the Naturhistorisches Museum in Vienna, examined in 1966, and the original descriptions of *crucians*, *ferruginosus*, *pungens* and *fatigans* by Wiedemann, and the original descriptions of *punctipennis* and *quinquefasciatus* by Say. It is suggested that the following actions be taken: designation of a neotype for *quinquefasciatus* and an application to the International Commission on Zoological Nomenclature for suppression of *ferruginosus*.

For over 50 years, two different specific-group names (*quinquefasciatus* Say, 1823 and *fatigans* Wiedemann, 1828) have been used for the same ubiquitous, economically and medically important species, popularly known as the Tropical (Southern) House Mosquito. In 1957 Alan Stone, in preparation for a catalog of the mosquitoes of the world, reviewed this vexing problem, came to the conclusion that it was zoological rather than nomenclatorial, and on this basis adopted *quinquefasciatus* as the name to be used in the catalog (Stone, Knight and Starcke, 1959) with the hope that this would result in the solution of the problem and in uniform usage. Unfortunately this has not been the case; *fatigans* continued to be widely used in the Old World and was adopted by the World Health Organization in its reports and publications. A concerted effort is being made at the present time to reach an agreement for the rejection of one of the names and the uniform acceptance of the other.

During the summer of 1966, I had the opportunity of examining the Wiedemann material at the Naturhistorisches Museum in Vienna (NMW) through the courtesy of Dr. Max Beier. This material contains some specimens obtained from Thomas Say which are critical to the resolution of the controversy regarding *quinquefasciatus* and *fatigans*. The manuscript on my findings and analysis was prepared in the fall of 1966 and was circulated to Alan Stone, Kenneth L. Knight and Peter F. Mattingly. However, the only published information on this study (Belkin, 1968b:9, 19, 55, 57) deals with the designation of lectotypes for *Anopheles crucians*, *An. ferruginosus* and *Culex pungens*, all described by Wiedemann, 1828, and statements regarding the type-material of Wiedemann's species and their presence in NMW (Belkin, 1968b:9, 19, 55, 57), and the rejection of *ferruginosus* as a *nomen oblitum* and the retention of *atropos* Dyar and Knab, 1906 as the valid

specific name for a well known taxon (Belkin, Heinemann and Page, 1970:27).

To expedite the resolution of the controversy, the problem is re-examined here with due consideration of the original descriptions of Say and Wiedemann and the material examined at NMW in the summer of 1966. Since the nominal species *Anopheles crucians*, *An. ferruginosus*, *An. punctipennis* and *Culex pungens* are intimately involved in the problem, they are also considered.

Wiedemann Types and Descriptions

crucians. There are five females in NMW collection with *crucians* labels which are probably all part of the type-series. The specimen bearing the following labels was designated as the lectotype (Belkin, 1968b:9): // [small square red label] // Coll. Winthem [printed] // *crucians* [ink] / det. Wiedem. [printed] // *crucians* W/N Orleans [ink] //. All specimens agree quite well with the description except in the statement: "in der Ruhe, wo die Flügel auf einander liegen, sieht man jenseits der Mitte eine blasse Binde, die an den einzelnen Flügeln wenig oder gar nicht bemerkbar ist", which seems to be a rewording of part of Say's description and comments on *punctipennis*: "When the insect is at rest, the wings being incumbent one on the other, the pale band is very distinct . . . with a hardly perceptible pale band beyond the middle. . .". Wiedemann cites *Culex punctipennis* Say as a synonym of *crucians*, but it is obvious from the original descriptions that two different taxa are involved and these have been recognized as distinct for a long time (Howard, 1896:23).

ferruginosus. There are three females in NMW collection with *ferruginosus* labels which are probably all part of the type-series, all in poor condition. The specimen bearing the following labels was designated as the lectotype (Belkin, 1968b:9-10): // *ferruginosus* [ink] / Coll. Winthem [printed] // *ferruginosus* / W. N Orleans [ink; Wiedemann's hand?] //. The lectotype has the palpi broken at end of the second segment (basal long segment) and lacks antennae, abdomen and right hindleg. All three specimens agree quite well with the original description in the remaining parts except for the statement: "Beine kürzer als bei der vorigen Art [*crucians*], schwärzlichbraun, mit gelblichen Schenkeln," which again seems to be a rewording of part of Say's description and comments of *quinquefasciatus*: "Legs much shorter than those of the preceding species [*punctipennis*] . . . feet moderate, fuscous, thighs whitish".

Wiedemann's *ferruginosus* is undoubtedly *Anopheles atropos* Dyar and Knab, 1906 of current usage. The significant statements in the description are: "Fühler und Taster braun, diese dunkeler mit an der Wurzel wenig schneeweissen Gliedern . . . Flügeladern braunbeschuppt; Schwinger fast weiss mit braunem Knopf".

I am confident that Howard, Handlirsch and Coquillett (Coquillett, 1906:7) were mistaken about the identity of the types of *ferruginosus*. I concur with Alan Stone (*in litt*) that it is hard to believe that Howard, in 1905, could not distinguish an *Anopheles* from a *Culex*. However, the three females of *ferruginosus* I examined had the palpi broken and lacked many other structures. This, coupled with unspotted wings, gives the specimens a *Culex*-like appearance; as a matter of fact, I was fooled for a minute when I first looked at a specimen, expecting it to be a *Culex*.

In Coquillett's discussion (1906:7) the only reference to the types of *ferruginosus* is: "It is represented in the Vienna museum by four specimens of a *Culex*; this is in perfect accord with Say's statement that the legs of this species [*quinquefasciatus*] are much shorter than those of *Anopheles punctipennis*." It is strange that in this discussion no mention is made of any character of the type-specimens of *ferruginosus*, not even a confirmation of the relative leg length, while some details are given for the types of *fatigans* and *pungens* which were examined at the same time. I believe that there is at least a possibility that Howard saw the same material that I did, in part at least, and that he made a very superficial examination. It is, of course, possible that Howard and I examined different specimens. This is suggested by the fact that I found only three specimens labeled *ferruginosus* instead of four seen by Howard. Possibly significant in this connection is one female *Culex* bearing only the printed label // Coll. Winthem // which I found among the miscellaneous material in the general series; this specimen could have been included in the *ferruginosus* series in Howard's time and might be the one examined by him. This specimen may be part of the original series of one of Wiedemann's species but, of course, without a locality or species label it cannot be assigned definitely to any of them now. I believe that it may be part of the *pungens* material, and I have placed it there.

Whether Howard made his decision upon a superficial examination of the one specimen bearing the handwritten *ferruginosus* label (the designated lectotype) or saw a different series of specimens which were *Culex* does not really matter. The specimens labeled *ferruginosus* which I examined agree with the original description in all significant characters and are undoubtedly part of the type-series. The description of *ferruginosus* is of a species of *Anopheles* and not *Culex*. Every other species of *Anopheles* treated by Wiedemann in the same publication is in fact an *Anopheles*, indicating that Wiedemann knew what he was doing when he placed *ferruginosus* in *Anopheles*.

The description of *ferruginosus* by Wiedemann does not fit *quinquefasciatusfatigans* in any significant characters. Therefore, Howard's identification of *ferruginosus* as a *Culex* was erroneous.

pungens. There are three females in NMW collection with *pungens* labels, which are probably all part of the type-series. An additional female *Culex*, mentioned above under *ferruginosus*, may be part of this series. The specimen bearing the following labels was designated as the lectotype (Belkin, 1968b:19): // [small square red label] // Coll. Winthem [printed] // *pungens* [ink] / det. Wiedem. [printed] // *pungens* W. / N Orleans [ink] //. All four specimens agree quite well with the description. I believe that they are *quinquefasciatus-fatigans*, although without a male a positive identification is impossible. I could find no character to suggest any other species of *Culex*. The original description and the handwritten label on the lectotype indicate New Orleans as the provenance of the material. Although there is no statement in the description or on the labels that this material came from Say, it appears probable that it did in fact come from him, as all other mosquito material from New Orleans in Wiedemann's publication (*crucians*, *ferruginosus*) did in fact come from Say (footnote under *ferruginosus*, p. 12; see next section on Wiedemann's material). This is a crucial point, and if we accept it then we can resolve the problem. Since these specimens fit Say's description of *quinquefasciatus*, I believe that Wiedemann described Say's species as *pungens* and incorrectly applied the name *quinquefasciatus* to an *Anopheles* which he renamed *ferruginosus*.

fatigans. In the NMW collection there are two specimens, one male and one female, each with two combination printed and handwritten labels, one locality, the other species. Both specimens are in poor condition, rubbed and faded; unfortunately, the male lacks genitalia and there is no indication of who made the preparation or where it is. The female bears the following labels: // [small square red label] // Ind. orient [ink] / Coll. Winthem [printed] // *fatigans* Wied/ Ind. orient [ink] // *fatigans* [ink] / det. Wiedem. [printed] //. This specimen was designated as the lectotype by Belkin (1968a:68).

Howard examined the female in 1905 and made notes on the tarsal claws and wing venation (Coquillett, 1906:8), but no notation of the male. These two specimens appear to be the authentic type-material and, although in poor condition, there is nothing in external characters different from the Tropical House Mosquito. The female is unquestionably a member of the *pipiens* complex and the remains of the male are also consistent with this. The female fits the original description quite well. The use of "flavidis" and "gelblich" in the description is misleading, the parts so described are very light yellowish brown as is common in faded and rubbed specimens such as Wiedemann's types. "Untergesicht schneeweiss" is a little puzzling; I think it may refer to the very pale ventral membrane at the base of the palpi and proboscis. This membrane is conspicuous and shiny in the male particularly.

Wiedemann's Material

We have to accept, at least in part, Wiedemann's statement that his descriptions of *crucians* and *ferruginosus* were based on specimens which Say himself had seen: "Alle von *Thom. Say* aufgeführten Arten habe ich, ausser wenigen mit † bezeichneten [*Culex triseriatus* and *Corethra punctipennis*], nach den Originalien selbst beschrieben (footnote under *ferruginosus*)." I am confident that the specimens of these species in NMW in 1966 were actually the specimens from Say, as they agree remarkably well with Wiedemann's descriptions.

These specimens bear no original Say label, only Wiedemann and, or Winthem labels and there is no way of determining whether or not Say himself labeled them in any way. Again, we have to accept for these specimens the localities specified on the Winthem/Wiedemann labels. We are interested here only in the specimens labeled New Orleans. These include the type-material of *crucians* and *ferruginosus*. The type-material of *pungens* is also from New Orleans, but unfortunately there is no statement that it came from Say. However, since the only other mosquito material from New Orleans mentioned in Wiedemann's publication is stated to have been derived from Say (*crucians* and *ferruginosus*), I believe it is safe to assume that the specimens of *pungens* were also among the same material.

Wiedemann's statement that his descriptions of Say's species were on the original material ("nach den Originalien selbst") cannot be taken to mean that he examined the actual specimens from which Say drew up his own original descriptions (types). I believe that Wiedemann's statement is best interpreted, as in the past, to mean only that he examined material identified by Say himself. This may or may not have included some of the actual type-series. All sorts of errors may have occurred in this material, in selecting the specimens, labeling, during shipment and after arrival. Additional species may have been included as well as mixed series in shipment, and some of the material may have been lost during transit and the labels (if any) misplaced.

I have been puzzled by Wiedemann's renaming of Say's *punctipennis* and *quinquefasciatus* as *crucians* and *ferruginosus* respectively. Apparently he did not do this as a rule in transferring species to a different genus (e.g. *Beris dorsalis* = *Sargus dorsalis* Say). The reason may have been that the specimens before him did not agree with Say's descriptions. The latter is quite evident when we compare them now. As I have noted above under *crucians* and *ferruginosus*, Wiedemann retained in modified form some of Say's statements which actually do not apply very well to the type material of *crucians* and *ferruginosus*. This suggests that the material before Wiedemann was either unlabeled or incorrectly labeled or that Say's species were composite. Therefore, we can not accept Wiedemann's identifications of Say's

species without comparing the specimens in NMW with Say's original descriptions.

Wiedemann had before him authentic specimens of *An. quadrimaculatus* Say, 1824, and he described this species, crediting it to Say and without renaming it. I did not see any material of *quadrimaculatus* in NMW and know of no published record of it except in Wiedemann.

Say's Descriptions

punctipennis. The only statements in the original description which can be used to identify the species of *Anopheles* involved are: "wings hairy, dusky, with a hardly perceptible pale band beyond the middle . . . When the insect is at rest, the wings being incumbent one on the other, the pale band is very distinct . . ." These characters have been used to identify this species as the *Anopheles punctipennis* of current usage, which shows the pale band very strikingly when the wings are superimposed. As Wiedemann received specimens presumably identified as *punctipennis* which he described as *crucians*, Say may have included the latter in his concept of *punctipennis*. *Anopheles crucians* certainly does not show a "very distinct" pale band on the wing, but it does have some pale areas and it is probable that Say placed in his *punctipennis* all mosquitoes with pale scales on the wing. In Wiedemann's description of *crucians*, the pale band is stated to be distinct (not very distinct) on the superimposed wings and hardly or not at all perceptible on the individual wing: "in der Ruhe, wo die Flügel auf einander liegen, sieht jenseits der Mitte eine blasse Binde, die an den einzelnen Flügeln wenig oder gar nicht bemerkbar ist." Even this hardly applies to *crucians* and I believe that perhaps Wiedemann included this in his description because it formed such a conspicuous part of Say's description and because he thought that the band might be more conspicuous in some of Say's other specimens.

The evidence is quite clear, I believe, that Say's *punctipennis* was a composite species. Therefore, the two species involved must be preserved in the current usage.

quinquefasciatus. I agree with Alan Stone (1966, in litt.) that the most reliable source for the identification of *quinquefasciatus* is Say's original description, no matter how poor and whether or not it was based on more than one species. I also agree with Alan Stone (1957:343) that a number of conspicuous characters in the description point to a species of *Culex* rather than *Anopheles*: "Legs much shorter than those of the preceding species [*punctipennis*] . . . abdomen cinereous; tergum with five black, broad fasciae . . . The hairy covering is very deciduous, and when an individual is caught by hand, the back of the thorax, in consequence of being denuded by the touch, exhibits the dorsal vittae of a blackish colour confluent at the

base, with an oval black spot on each side." I would also add: "thighs whitish", a conspicuous feature of *quinquefasciatus-fatigans* not seen in any dark *Anopheles*. Particularly significant, of course, is the abdominal banding from which the specific name is obviously derived. The name *quinquefasciatus* should be applied to the form with the abdominal banding in case the nominal species was composite. The description of the banding is inaccurate but is still recognizable as that of a *Culex* with the ventral surface and base of the abdominal segments dorsally pale, of a greyish color, and the rest of the dorsal surface of the segments dark. Other than "tail black above", there is really nothing in the description of *quinquefasciatus* that would definitely indicate an *Anopheles*. The statement: "halteres entirely whitish" might suggest *walkeri* but some *quinquefasciatus* have them definitely pale and they were described by Wiedemann as yellowish for *pungens*. "We found them in great numbers on the Mississippi in May and June", as was indicated by Belkin, Schick and Heinemann (1966:4), probably refers to Say's travels on the Mississippi north of the Ohio River in 1819 and could apply to any dark mosquitoes Say observed before the actual description of *quinquefasciatus*.

Conclusions

None of the above mentioned characters (except the legs) in the description of *quinquefasciatus* is in Wiedemann's description of *ferruginosus* and none of them fits the type-specimens of the latter. The legs are a little shorter (not much shorter) perhaps in *ferruginosus* than in *crucians*, but the femora are not yellowish. Again, as in the case of *punctipennis-crucians*, Wiedemann apparently modified some of the statements in Say's description. As indicated above under *pungens*, I believe that Wiedemann probably received from Say the specimens of *Culex* from New Orleans which Wiedemann described as *pungens*. The description of *pungens* agrees with that of *quinquefasciatus* in the all important character of abdominal markings, although this is stated in a reverse way and the color terminology is different: "Hinterleib braun, mit deutlich gelblichen Abschnitten; zwei oder drei letzte Abschnitte an beiden Seiten mit gelblichem Striemenchen." This species, *pungens*, is certainly *quinquefasciatus* of American authors. Therefore, I believe that Wiedemann misidentified Say's *quinquefasciatus* and redescribed it as *pungens* and applied Say's name to a different species which he renamed *ferruginosus*. The most likely reason for such an error may have been mislabeling of Wiedemann's specimens from Say, but it is possible that Say included in his *quinquefasciatus* all dark mosquitoes without conspicuous wing, thorax or leg markings.

There is no doubt in my mind that *quinquefasciatus* Say, 1823 and *fatigans* Wiedemann, 1828 both refer to the Tropical (Southern)

House Mosquito as analyzed here and determined earlier by Alan Stone (1957:342-344). Therefore, it is strongly urged that *quinquefasciatus* be used as the specific-group name for the Tropical (Southern) House Mosquito because of priority over *fatigans*.

To formalize this and eliminate ambiguity the following actions should be taken as soon as possible:

1. Designation of a neotype for *quinquefasciatus*. Although it is possible that the type-series of *pungens* in NMW are syntypes of *quinquefasciatus*, this cannot be proved with certainty and is actually quite improbable. Leaving *quinquefasciatus* without a type-specimen would only continue the controversy. Therefore, a neotype specimen should be designated. The type-locality for *quinquefasciatus* has been restricted to the vicinity of New Orleans, Louisiana by Belkin, Schick and Heinemann (1966:5) and an individual from a series of specimens reared from an egg raft collected 18 September 1969 in New Orleans is now available for designation of a neotype.

2. Suppression of *ferruginosus*. Application should be made to the International Commission on Zoological Nomenclature for the suppression of *ferruginosus* Weidemann, 1828, senior subjective synonym of *atropos* Dyar and Knab, 1906 (Belkin, 1968b:10), rejected as *nomen oblitum* by Belkin, Heineman and Page (1970:27).

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A NEW SPECIES OF SCAPTIA (MYIOSCAPTIA) FROM
NORTHERN QUEENSLAND (DIPTERA: TABANIDAE)¹

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ABSTRACT—*Scaptia* (*Myioscaptia*) **inopinata** is described from Northern Queensland.

On a recent trip to Australia, Fairchild was able to spend a week collecting in the vicinity of Cairns, Northern Queensland. Through the great courtesy of Mr. and Mrs. Alan Walford-Huggins, two days were spent on the Little Mulgrave River near Gordonvale. The collecting site was in heavy tropical rainforest along the rocky banks of this small river. Tabanidae were quite abundant, contrary to experience elsewhere near Cairns, and we took some 13 species, both attacking us and in a large flight trap.

Metallic blue *Scaptias* were especially abundant and persistent in their attacks, and seemed to consist of two very similar species, one with bright coppery-red eyes and bright silvery frons, the other with reddish-brown eyes and a more greyish frons. No differences in habits were noted and the two forms were taken in about equal numbers, both attacking us and in the flight trap.

Upon conferring with Mackerras in Canberra, it appeared that only one species of brilliantly metallic *Scaptia* has been hitherto recognized, *S.* (*Myioscaptia*) *violacea* (Macq.), and both forms stood under this name in the collections at Canberra. Further study by both of us revealed other small but consistent differences, discussed below.

The identity of the true *S. violacea* was confirmed for us by Dr. L. Tsacas of the Museum d' Histoire Naturelle in Paris who very kindly compared both forms with Macquart's type, which probably came from the vicinity of Sydney.

Scaptia (*Myioscaptia*) *inopinata* Fairchild and Mackerras, new species

Very similar to *S.* (*M.*) *violacea* but differing by lacking greyish pruinose stripes on mesonotum, being more brilliantly metallic, and in bearing a small tuft of black hairs on the margin of the calyptal fold, whitish in *violacea*.

Female. Length, 8 mm; wing, 9 mm. Eyes densely pilose, coppery red in life, becoming bronzy black on drying. Frons 3.2 times as high as basal width,

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slightly narrower at vertex, clothed with silvery white pubescence and scattered erect black hairs. Three prominent dark brown ocelli at vertex and short transverse ridgelike median protuberance about $\frac{1}{4}$ distance from base to vertex of frons. Subcallus with same white pollinosity as frons. Fronto-clypeus and genae blackish, subshiny, sparsely black-haired. Proboscis black, theca and labella sclerotized and shiny, the latter compact, proboscis slightly less than head height. Palpi yellow, pale haired except for scattered blackish hairs on margins, flat and leafshaped. Antennae with scape and pedicel dark brown, thinly grey pollinose, beset with long dark hairs. Flagellum yellow, of 8 segments, first as long as next 3 together, last segment about twice length of preceding segment, pointed.

Mesonotum and scutellum brilliant shining prussian blue, without grey pruinosity. Prothoracic lobes horn-colored. Notopleural lobes duller blue, pleura, sternum and coxae bluish black subshiny, black haired, including tuft on calyptal fold and near the base of alula beneath wing. Legs black, except pulvilli yellow and undersides of tarsi rufous-haired. Wings glass-clear, only costal cell very slightly yellowish, venation normal, stigma broad and black. Halteres dull brown.

Abdomen shining metallic purple above, somewhat more bluish below, sparsely short dark-haired, inflated and plump.

Holotype ♀, Northern Queensland, Cairns district, Gordonvale, Little Mulgrave River 12 Nov. 1972, attacking man. G. B. Fairchild coll.

Male. Length, 8.5 mm; wing, 9 mm. Eyes barely holoptic, long pilose, upper $\frac{2}{3}$; bronzy and facets slightly larger than those of lower greenish-black $\frac{1}{3}$. Larger facets not clearly demarkated from the smaller. Eye color in life unknown. Frontal triangle silvery pollinose, subcallus yellowish pollinose in middle, brownish at sides. Proboscis as in female, but more slender. Antennae more slender than female, scape and pedicel yellowish brown, flagellum yellow, with terminal segment slightly dusky. Palpi cylindrical, porrect, brown, terminal $\frac{1}{3}$ with flattened yellow area on outer side.

Mesonotum and scutellum brilliant shiny metallic bottle green, without pollinosity. Prothoracic lobes horn-colored. Notopleural lobes, pleura, sternum and coxae duller green. Hairs including tuft beneath wings black. Legs as in ♀. Wing as in ♀, except stigma yellow, inconspicuous. Halteres yellowish brown.

Abdomen concolorous with mesonotum, except 3rd and succeeding segments are increasingly yellowish green to brassy, and hairs denser and longer than in ♀.

Allotype ♂, Northern Queensland, Lamb Range, Mt. Tiptree, 3500 ft., 15 Nov. 1972, A. and M. Walford-Huggins colls.

Paratypes, 27 ♀♀, same locality and collector as holotype, 9 and 12 Nov. 1972, attacking man and in flight trap; 1 ♀, N. Queensland, Cairns district, Crystal Cascade, 10 Nov. 1972, Geo. Brooks coll.; 1 ♀, same data as Allotype; 1 ♀, N. Queensland, Kuranda, Oct. 1910, F. P. Dodd coll.; 1 ♀, N. Queensland, Palm Island, Dec. 1931, Mackerras coll. 1 ♀, N. Queensland, Dambulla, 24 Oct. 1962 Marks and Barrow Colls.; 1 ♀ N. Q., Yungaburra Dec. 1961, B. L. and B. May coll. Holotype, allotype and some paratypes to be deposited in Australian National Insect Collection, Canberra. Other paratypes in Coll. G. B. Fairchild.

The paratypes vary somewhat in size, from a wing length of 7 mm to 9 mm. Color also is variable, ranging from pure blue to rich violet, the mesonotum, scutellum and abdomen being either concolorous or not, in various combinations. Only the Palm Island specimen is slightly greenish, though not so green as the male. Palpi are variable in shape, from almost as broad as long to twice as long as broad. Antennae may be wholly yellow, or last segment more or less dusky. Wing stigma is usually black, more rarely brown, but no females have it as pale as in the male. Measurement of frons of 16 specimens give a median index (length)/(basal width) of 3.15, and mean of 3.12, with a range from 2.9 to 3.4.

The species needs comparison only with *S. (M.) violacea*.

In *violacea* the frons averages somewhat narrower, median index 3.85, mean 3.66 with a range of 3.2 to 4.6, 33 specimens measured. The eye is dull reddish brown in life. The mesonotum is duller, with a definite pair of dorsolateral greyish pollinose stripes at least anteriorly. The notopleural lobes, pleura and coxae are hardly metallic, being dull greyish black with hardly a trace of blue. The hairs of the small tuft on the calyptal fold near base of alula are creamy white, contrasting with the remainder of the vestiture. The pollinosity of frons is grey, not silvery white, and there is usually a well-marked denuded club-shaped median callus. Legs, palpi, antennae and wings are the same as in *inopinata*, though stigma is frequently yellowish brown. The abdomen is much as in *inopinata* but slightly duller and with some grey pruinosity on first and second segments laterally and ventrally. Colors are about the same, though *violacea* seems to be more often bluish to greenish than purple. Specimens of *violacea* taken with *inopinata* contrast more with the latter, being duller and more pollinose than those from S. Queensland where *inopinata* has not been taken.

Material examined (listed from north to south). *Queensland*: 6 ♀ Mossman Gorge, 27 Oct. 1966, in rain forest, E. B. Britton coll.; 1 ♀ Dambulla, 24 Oct. 1962, biting in bush 1500–1700 hrs., E. N. Marks & G. Barrow coll.; 1 ♀ Mt. Lewis via Julatten 3500–4000', 26–28 Nov. 1965, G. B. Monteith coll.; 1 ♀ Kuranda, F. P. Dodd coll.; 2 ♀ Cairns dist., Crystal Cascade, 10 Nov. 1973, George Brooks coll.; 34 ♀ Gordonvale, Little Mulgrave R., 9 and 12 Nov. 1972, attacking man and in flight trap, G. B. Fairchild coll.; 1 ♀ Atherton dist., The Crates, 7 Dec. 1966, B. Cantrell; 2 ♀ Eungolla, nr. Mackay, Oct. 1928, G. M. Goldfinch and A. T. Turner coll.; 1 ♀ Gympie dist., 5 Nov. 1957, T. E. Woodward coll.; 1 ♀ Bunya Mts., 14 Dec. 1957, F. A. Perkins coll.; 1 ♀ Kilcoy, 29 Dec. 1925; 1 ♀ Woodford, 12 Nov. 1924; 1 ♀ Mt. Glorious, 6 Nov. 1962, S. Fanning coll.; 1 ♀ Brisbane dist., Highvale, 10 Dec. 1959, R. Straatman coll.; 1 ♀ Toowomba, Dec. 1932, T. Greaves coll.; 16 ♀ Mt. Tamborine, 4 Nov. 1961, I. F. B. Common & M. S. Upton coll.; Dec. 1961, C. R. Eden coll.; 1 ♀ Thunderbird Park, 16 Nov. 1972, in flight trap, G. B. Fairchild coll.; 5 ♀ Rathdowney, Palcer Creek State Forest, 13 Dec. 1966, T. G. Campbell coll.; 1 ♀ Upper

Coomera R., 16 Nov. 1972, attacking man, R. Sutherst coll.; 1 ♀ Springbrook, 4 Dec. 1949, I. M. and M. J. Mackerras coll.; 2 ♀ Binna Burra, Dec. 1957, E. M. Exlay coll.; 1 ♀ Surprise Rock, 14 Nov. 1952, biting man, I. M. Mackerras; 10 ♀ National Park, Dec. 1921, H. Hacker coll., Jan. 1928, A. J. Nicholson coll., 2 Nov. 1956, F. A. Perkins coll.; 2 ♀ McPherson Range, 2000-3000', Dec. 1919; 1 ♀ Mt. Barney, 24 Dec. 1961, J. Bryan coll. *New South Wales*: 4 ♀ Kyogle dist., Paddy's Flat, 13 Nov. 1961, J. H. Calaby coll.; 1 ♀ Mt. Matheson, 2400', 12 Dec. 1962, K. R. Norris coll.; 1 ♀ Dorrig National Park, 11 Nov. 1967, N. Dobrotvorsky coll.; 1 ♀ Comboyne, 9 Nov. 1917, F. R. Pfeiffer coll.; 2 ♀ Kundibakh, nr. Taree, C. Dennes coll.; 1 ♀ Upper Williams R., Barrington House, 28 Dec. 1965, B. Cantrell coll. After the above description was set in type, further material was received from the U.S. National Museum, consisting of 3 ♀ Paratypes of *S. inopinata* from Palm Island, N. Queensland, no date or collector, and 3 ♀ of *S. violacea*, Sydney, N. S. Wales (1); National Pk., Queensland, 3000 ft., 2 Nov. 1952 (1); and Mt. Lindsay, S. Queensland, 26 Dec. 52 (1).

Finally, it has also been possible to re-examine most of the specimens of "*violacea*" recorded by Mackerras (1960). The male and female terminalia illustrated in fig. 43 (p. 33) and 160 (p. 129) are of *inopinata* from Palm Island. We have not found a male of *violacea* in any collection, old or recent; the terminalia of a dissected female from the National Park, S. Queensland, did not appear to differ in any significant way from those of the *inopinata* female noted above, a further indication of the close relationship between the two species. The combined distribution listed on p. 124 is corrected in the present paper, except for the records from Babinda and Mt. Spec, N. Queensland, which we have unfortunately not been able to check.

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CECIDOMYIIDAE (DIPTERA) FROM CANADIAN AMBER

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ABSTRACT—Four new genera and 4 new species (*Cretocatocha mecalpinei*, *Cretocordylomia quadriseries*, *Cretowinnertzia angustala*, and *Cretomiastor ferejunctus*) are described from specimens embedded in Canadian amber from the Cretaceous period. The genera are assignable to 4 tribes of the more primitive, extant Cecidomyiidae.

Seventy-five million years ago, cecidomyiids existed that were not conspicuously different from some living today. The four species from Cretaceous amber described below each belong to a different tribe of Lestremiinae or Porricondylinae; they establish a new minimum age for these tribes, which previously were known to be only as old as the Eocene period (Meunier, 1904). Modern members of these tribes are sapromycophagous and of wide geographical distribution.

The venation pattern of the wings and the general appearance of extant cecidomyiids are already well established in these fossils, yet in certain characters, e.g. the setiform antennae of *Cretocatocha mecalpinei* and the simple cubitus of *Cretowinnertzia angustala*, some of the fossils are more specialized than their modern relatives. That these fossils fit so well in the tribal classification of modern forms indicates that the sapromycophagous cecidomyiids appeared long before the latter part of the Cretaceous period, in which the present fossils appeared. Schlee and Dietrich (1970) reported cecidomyiids from Lower Cretaceous amber from Lebanon, but those fossils are as yet undescribed.

The Canadian amber fossils are represented by 16 pieces found on the shores of Cedar Lake, Manitoba, and near Medicine Hat, Alberta. McAlpine and Martin (1969) have discussed the history and collections of Canadian amber. The Alberta specimens are associated with the Foremost Formation, 73 to 74 million years old, and the pieces found along the banks of Cedar Lake, Manitoba, are thought to have been washed down the Saskatoon River from that same Formation. This hypothesis is supported by the fact that one of the species, *Cretomiastor ferejunctus*, described below, was found at both sites. I was able to study the pieces of amber through the courtesy of Dr. J. F. McAlpine of the Biosystematics Research Institute, Agriculture Canada, and Dr. F. M. Carpenter of the Museum of Comparative Zoology in Cambridge, Massachusetts.

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Although many of the specimens are in very good condition for fossils, antennal sensoria, usually critical for generic placement and, in this case, of special interest because of the age of the specimens, are not visible. Non-setal sensoria are colorless and are best seen in modern specimens with a phase-contrast microscope, but these pieces of amber are too large for viewing under a compound microscope and cannot be made smaller without danger of fracturing. The abbreviations CNC and MCZ below stand for Canadian National Collection and Museum of Comparative Zoology respectively.

I am pleased to dedicate this paper in honor of my friend and former colleague, Dr. Alan Stone. Always a model of competence and efficiency, Dr. Stone is assured lasting respect in the field of Diptera taxonomy.

Subfamily Lestremiinae

Tribe Catochini

Cretocatocha Gagné, new genus

Male antenna setiform, with 8 flagellomeres, I and II connate, III-VIII tapering gradually as a unit to bristlelike tip. Only setiform sensoria apparent. Eye bridge present. Palpus 4-segmented. Wing vein R_5 shorter than wing. Claws bowed, simple. Empodia rudimentary.

Type species, *Cretocatocha mcalpinei* Gagné

The wing is similar to *Anocha* spp., but the setiform antennae are unique in the Catochini. In several genera, e.g. *Tritozyga* (which has a much different wing), species have the antennal flagellomeres reduced in number from the primitive 14 to 8, but in those cases, only the last 1-3 flagellomeres are narrowed and pointed.

Cretocatocha mcalpinei Gagné, new species

Male head, wing, and tarsus as in fig. 1-3. Wing: Length, 1.3 mm; membrane without macrotrichia.

Holotype: ♂, near Medicine Hat, collected V-1973, J. F. McAlpine and H. J. Teskey, CAS 593, deposited in CNC, Ottawa.

This species is named in honor of J. F. McAlpine of the Biosystematics Research Institute, Agriculture Canada, in appreciation for his leadership in the study of insects from Canadian amber and for the help he has given me in my studies on Cecidomyiidae.

Tribe Micromyini

Cretocordylomyia Gagné, new genus

Antenna with 12 flagellomeres, those of male with 4 crenulate whorls of long setae, those of female distally with more numerous and shorter setae than basally; non-setal sensoria not apparent. Wing: C extending beyond tip of R_5 ; R_1 more than twice length R_5 ; Cu fork forming acute angle. Empodia about as long as claws, broad. Female with 2 large, round, subequal spermathecae.

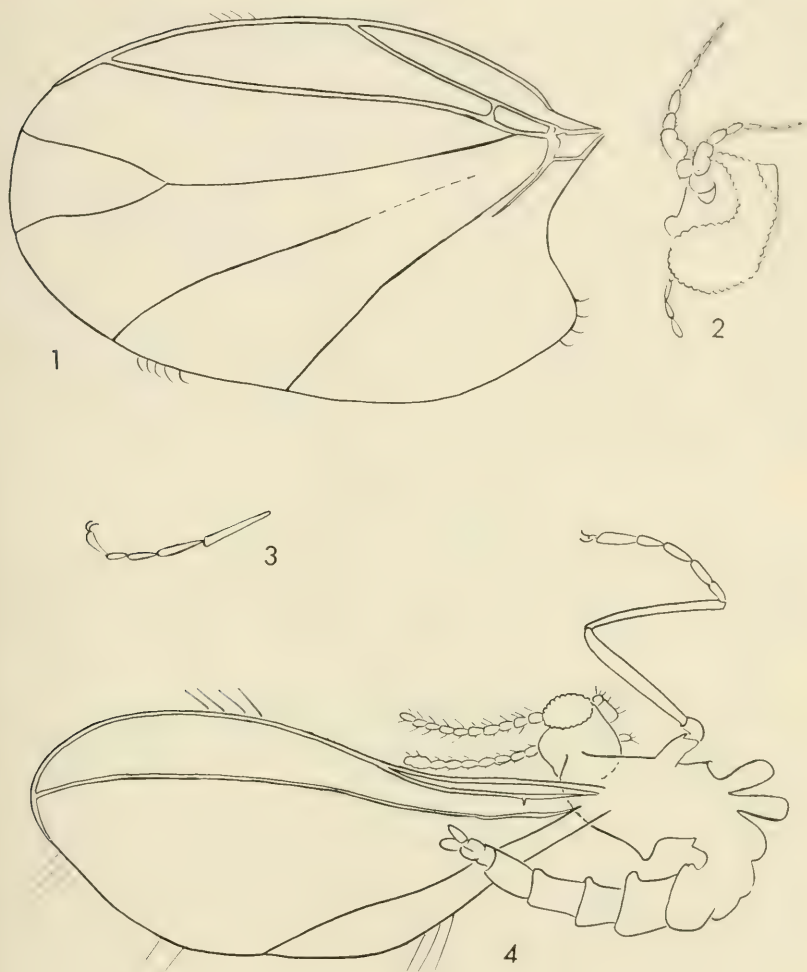


Plate 1

Fig. 1-3, *Cretocatocha mcalpinei* (holotype). 1, wing. 2, head. 3, foretarsus.
Fig. 4, *Cretomiasor ferejunctus* (holotype).

Type-species, *Cretocordylomyia quadriseris* Gagné

This genus is close to *Cordylomyia* and *Campylomyza* by reason of the long, broad empodium and long R_1 wing vein. Species of those two modern genera do not have more than $2\frac{1}{2}$ crenulate whorls of long setae on the male flagellomeres. The female flagellomeres of *Cretocordylomyia quadriseris* are similar to those of *Cordylomyia*

spp. Details of antennal sensoria and male genitalia that could further clarify relationships are not apparent or obstructed from view.

Cretocordylomyia quadriseries Gagné, new species

Wing (fig. 5): Length, 1.0 mm in male and female. Antenna: Male flagellomere III as in fig. 6; female flagellomere III as in fig. 7.

Holotype: ♂, Cedar Lake, Manitoba, MCZ #6931, F. M. Carpenter Collection, deposited in MCZ. Paratype: ♂ in same piece of amber as holotype (position relative to holotype marked on vial). Additional specimen: ♀, Cedar Lake, collected VIII-1963, J. E. H. Martin and J. F. McAlpine, CAS 24, deposited in CNC.

The female is tentatively referred here because its wing is similar to that of the male. The name "*quadriseries*" is a noun in apposition meaning "4 rows" in reference to the 4 crenulate whorls of setae on the male flagellomeres.

Subfamily Porricondyliinae

Tribe Winnertziini

Cretowinnertzia Gagné, new genus

Female antenna with 10 flagellomeres; non-setal sensoria not apparent. Eye bridge present. Palpus 4-segmented. M_{3+4} wing vein absent. Spermathecae not evident. Claws gently curved, simple. Empodia rudimentary. Ovipositor 3-segmented.

Type-species, *Cretowinnertzia angustala* Gagné

The wing is typical of Winnertziini with Rs placed at approximately a right angle to R_1 and R_5 and with M-rm straight. *Parwinnertzia notmani* Felt is the only other winnertziine without an M_{3+4} vein, but its wing is much narrower than that of *C. angustala* and its palpus is 2-segmented. The 2 species are not necessarily closely related; a wing vein or palpal segment could have been lost on different lines of evolutionary development. Most Winnertziini have characteristic horseshoe-shaped sensoria, but I could not determine their presence on the single specimen of *C. angustala*.

Cretowinnertzia angustala Gagné, new species

Wing length, 1.2 mm. Body outlined in Figs. 8-9.

Holotype: ♀, Cedar Lake, Manitoba, collected VII-1950, Bird and Brown, CAS 25, deposited in CNC.

The name "*angustala*" is a noun in apposition meaning "narrow wing."

Tribe Heteropezini

Cretomiastor Gagné, new genus

Female antenna with 10 flagellomeres, non-setal sensoria not apparent. Eye bridge not evident. Palpus 1-segmented, large. Wing: Broad, with fringe of

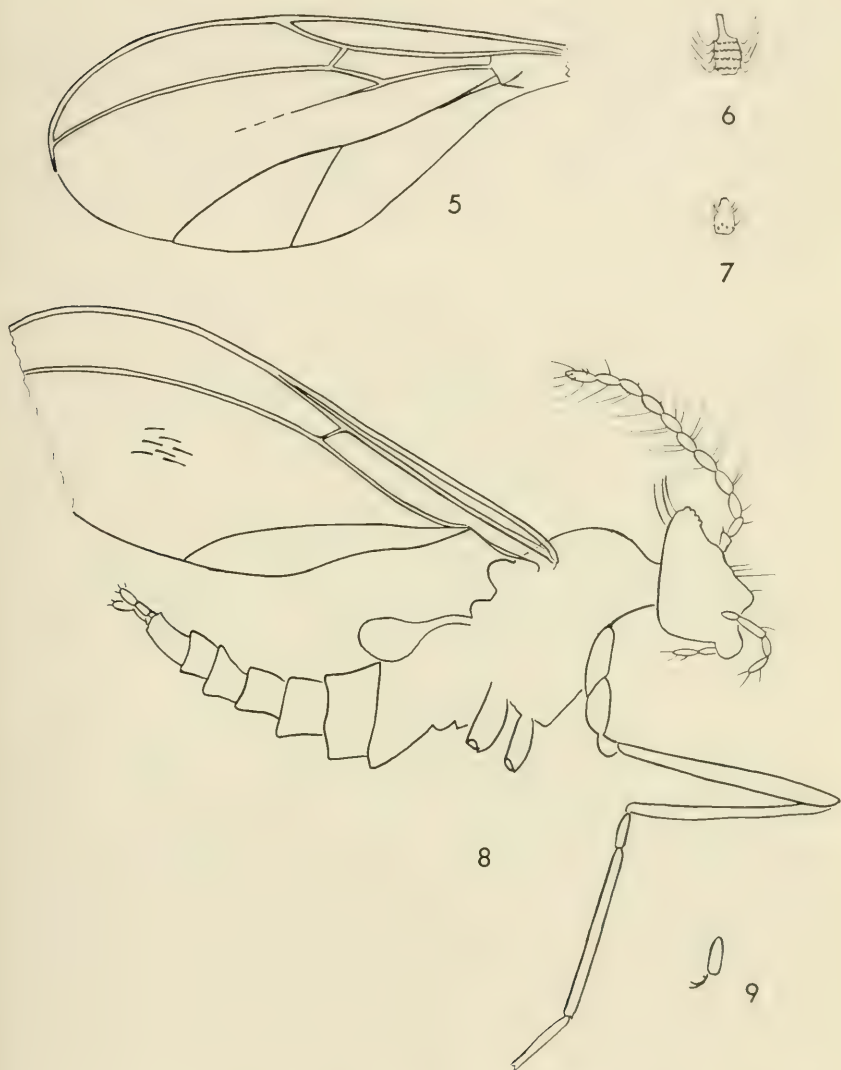


Plate 2

Fig. 5-7, *Cretocordylomyia quadriseries* (holotype). 5, wing. 6, ♂ flagellomere III. 7, ♀ flagellomere III. Fig. 8-9, *Cretowinnertzia angustala* (holotype). 8, outline of body. 9, hindtarsomere V.

long setae; membrane without macrotrichia; Cu present, simple. Tarsi 5-segmented, tarsomeres I and II more closely joined than other tarsomeres. Claws long, simple, evenly curved. Empodia short. Abdomen with 2 round spermathecae and 3-segmented cerci.

Type-species, *Cretomiastor ferejunctus* Gagné

Heteropezini have foreshortened tarsi, often of fewer than 5 tarsomeres. *Cretomiastor ferejuncta* has 5 tarsomeres but there is barely a separation between I and II, an indication that the reduction exhibited in the tribe today was begun long ago. Non-setal sensoria are not apparent, but if keyed in Wyatt (1967), the species might run to *Leptosyna* except that the wing of *C. ferejunctus* lacks macrotrichia. Key characters aside, the wing of *C. ferejunctus* is much broader than that of any *Leptosyna*.

Cretomiastor ferejunctus Gagné, new species

Wing length: 0.9–1.1 mm. Female is partially outlined in Fig. 4.

Holotype: ♀, near Medicine Hat, Alberta, collected by J. F. McAlpine, B. Cooper, and D. Daze, CAS 1163c, deposited in CNC. Paratypes (all ♀♀; all except the last item below from near Medicine Hat and deposited in CNC): same data as holotype except CAS 1163b; VII-8-11-1971, J. F. McAlpine, CAS 380 and 425; V-1973, J. F. McAlpine and H. Teskey, CAS 839 and 906; 1973, P. Boston, CAS 781a, 781b, and 1243; and Cedar Lake, Manitoba, MCZ #6937, F. C. Carpenter Collection, deposited in MCZ.

The name "*ferejunctus*" is an adjective meaning "nearly joined" in reference to the almost connate tarsomeres I and II.

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A NEW GENUS OF PSILOPINE FLIES (DIPTERA: EPHYDRIDAE) WITH NOTES ON ITS RELATIONSHIPS

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ABSTRACT—*Nesopsilopa* new genus with *stonei* new species, *bahamaensis* new species, type-species *umbrosa* (Loew) new combination, *caeruleiventris* (Loew) new combination, and species A are described from several Caribbean Islands and southern Florida. *Guttipsilopa* Wirth is also reviewed. Characters of the head, wing, and male genitalia are figured. *Nesopsilopa* and *Guttipsilopa* are placed in Psilopinae where they are intermediate between the tribes Psilopini and Discocerini. Characters for tribal recognition are discussed and it is provisionally suggested that Discocerini and Psilopini be combined.

When Cresson (1946) revised the Neotropical species of the subfamily Psilopinae, he provisionally placed *Psilopa umbrosa* Loew and *P. caeruleiventris* Loew in the genus *Rhysophora* Cresson. Cresson recognized that these two species could not be retained in the genus *Psilopa* Fallén, as then characterized, and for lack of a better generic association, he assigned them to *Rhysophora*. Cresson (1946:152) stated further, however, that both species “. . . may prove to be entitled to separate generic recognition, allied to the Oriental *Actocetor*.” Ten years later, Wirth (1956) proposed the monotypic genus *Guttipsilopa* for his new species *G. haydeni*. Wirth suggested that *Guttipsilopa* was allied with the genera *Actocetor* Becker (Old World) and *Trypetomima* de Meijere (Australasian), and he pointed out that these genera plus *Guttipsilopa* all had guttate wings and chaetotaxy similarities. Our purposes in the present paper are to present our interpretation of the taxa in question and review the New World species.

METHODS

The genera considered below are rare and are not well represented in collections. Our study was based on less than 30 specimens, of which 21 represented 1 species. Because of their rarity, we have cited the locality data and depository of each specimen.

Ratios have been used objectively to define three characters: Face width is expressed as a ratio of face width divided by head width, where the narrowest

¹ c/o U.S. National Museum, Washington, D.C. 20560.

distance between the eyes is the face width measurement and the widest distance of the head is the head width measurement. The costal vein index is the straight line distance between $R2 + 3$ and $R4 + 5$ divided by the distance between $R1$ and $R2 + 3$. The $M1 + 2$ vein index is the distance along the medius basad of tp (posterior crossvein) divided by the distance apicad of tp .

Nesopsilopa Mathis and Wirth, new genus

Type-species: *Psilopa umbrosa* Loew, by present designation.

Diagnosis: *Nesopsilopa* may be distinguished from related genera of the subfamily Psilopinae by the following characters: Body mostly brown to black; mesonotum, scutellum, and head heavily pollinose, gray to brownish gray; 2 pairs of proclinate fronto-orbitals, anterior pair much larger; 1 pair of reclinate fronto-orbitals situated caudad and mesad of the larger pair of the proclimates; post-ocellar bristles arising from points in line with posterior margin of posterior ocelli, proclinate; basal alignment of ocellar bristles variable; antennal arista with 5-9 branches; paired facial bristles numbering from 3-5; parafacies bare; genae narrow; less than $\frac{1}{4}$ eye height; notopleuron bare except for 2 pairs of large bristles; prescutellar bristles aligned approximately with intra-alars and posterior supra-alars; wing maculate, anterior margin infuscated; venation normal.

Description: Small flies, 2.73 to 4.00 mm long; generally dark colored although with gray, densely pollinose areas on head and thorax; wing maculate.

Head: Frons rectangular, wider than long, pollinose; ocellar triangle equilateral or isosceles; 3 fronto-orbitals, 2 laterally-aligned proclinate bristles and between them 1 reclinate bristle equal to length of verticals and arising slightly closer to anterior proclinate bristle; anterior proclinate bristle approximately twice the size of the smaller posterior proclinate; 1 pair of large, proclinate, parallel, ocellar bristles situated slightly anterior, laterad, or slightly posterior to anterior ocellus; postocellar bristles small, diverging, proclinate, and slightly larger than posterior proclinate fronto-orbital; inner and outer vertical bristles subequal to each other in size. Antenna entirely pale yellow; 2nd segment spinose, with 1 slightly larger bristle arising from anterodorsal surface; arista with 5-9 branches. Face much longer than wide, generally flat although protruding slightly toward lower $\frac{1}{2}$ and slightly receding toward oral margin; 3-5 large facial bristles and several smaller, incurved setae between larger bristles and parafacial suture; parafacies bare, linear, and narrow, enlarging only slightly around lower margin of eye. Eyes bare, oval, aligned perpendicular to plane of epistoma; gena narrow, less than $\frac{1}{4}$ eye height, and with several smaller setae and 1 or 2 larger bristles. Maxillary palpus mostly yellowish orange to yellow; clypeus exposed; concolorous with face; oral opening small.

Thorax: Mesonotum and scutellum densely pollinose, contrasting distinctly with pleuron which is more or less bare and shining. Chaetotaxy as follows: Several un-seriated rows of setae throughout acrostichal and dorsocentral areas, this area lacking any larger bristles except for 1 pair of prescutellars that are situated in line with a large pair of intra-alars and the posterior pair of supra-alars; anterior pair of supra-alars larger; 2 pairs of marginal scutellar bristles; disc of scutellum setulose: 1 pair of humerals; 2 pairs of notopleurals, both equally distant from notopleural suture, anterior bristle slightly closer to posterior bristle than to humeral bristle; 1 pair of presuturals; 2 pairs of mesopleurals, and 1

pair of sternopleurals. Legs dark brown to black basally, becoming paler toward apices, generally 3 to 4 tarsomeres yellow. Wing maculate, infuscation limited to anterior half; costal vein extending to $M1 + 2$; $R2 + 3$ nearly straight. Halter dark basally, becoming paler apically, capitellum white.

Abdomen: Dark brown to bluish black, subshining to distinctly shining with metallic reflections. Males with 5 visible segments, females with 6 to 7, sometimes the latter are telescoped into the 5th.

Distribution: The genus is restricted to the Western Hemisphere, with species known from the Greater Antilles and southernmost Florida.

Natural History: The immature stages are unknown. Adults are found on sea beaches, notably where seaweeds have washed ashore. A few adults were swept from two plant species of the family Asteraceae: *Borrichia arborescens* (L.) DC. (Sea Oxeye), and *Flaveria linearis* Lag. (Yellowtop). These plants grow on sea beaches and in hammocks or mangrove swamps.

Etymology: *Nesopsilopa* is of Greek derivation and is a combination of the feminine Greek noun *neso* meaning "island" and *Psilopa*, in reference to the island habitat of the *Psilopa*-like flies.

Discussion: Both previously described species of the genus *Nesopsilopa* were placed in *Rhysophora* (Cresson, 1946; Wirth, 1968). We are transferring these species to *Nesopsilopa* because of numerous dissimilarities between them and the type-species of *Rhysophora*, *robusta* Cresson. In general, *Rhysophora* is almost entirely dark brown to black, notably the antennae, and lacks dense pollinose areas over much of the dorsal surface of the head and thorax. In addition, the wings of *Rhysophora* are hyaline; the smaller proclinate fronto-orbital is very much reduced or is lacking; if present, it is inserted anterior or laterad of the reclinate fronto-orbital, never posterior of it; the arista has 9–11 branches (Notiphiline type); and the postocellars are relatively small and are laterocline.

Nesopsilopa caeruleiventris (Loew), NEW COMBINATION
fig. 5

Psilopa caeruleiventris Loew, 1862:144.

Rhysophora caeruleiventris (Loew); Cresson, 1946:152; Wirth, 1968:12.

Diagnosis: *Nesopsilopa caeruleiventris* is the largest species in the genus and can be confused only with *N. bahamaensis*. It is distinguished from *N. bahamaensis*, as well as other congeners, by the following characters: Length 4.0 mm, robust; ocellars inserted laterad of anterior ocellus; antennal arista with 8–9 branches; face wide, head-width to face-width ratio 1 : 0.35; 4 pairs of larger facial bristles, uppermost pair well above middle of face and distinctly separated from remaining facial bristles; parafacies moderately narrow, mostly linear, slightly enlarging along ventral margin of eye, eye to cheek ratio 1 : 0.14; anterior margin of wing infuscated, dark brown, posterior margin of infuscation distinct, sinuate, macula-



Figs. 1-2, oblique view of head. 1, *Nesopsilopa stonei*. 2, *Nesopsilopa umbrosa*.

tion pattern as in fig. 5; hind crossvein whitish; costal vein index 1 : 0.45; M1 + 2 vein index 1 : 0.74; scutellum dark brown, contrasting distinctly with grey mesonotum; abdomen bluish black, shining, metallic.

Type and Type-locality: Female holotype: "207; Loew Coll.; Type 12045 [red]; *Psilopa caeruleiventris* det. Cresson, 1921; *Rhysophora caeruleiventris* (Lw.) WWirth '61; *Nesopsilopa caeruleiventris* (Loew), Mathis & Wirth, 1977." The holotype is in the Museum of Comparative Zoology, Harvard University, type number 12045. Loew's original description of this species lists "Cuba" as the type-locality; no label indicating such presently accompanies the holotype.

Nesopsilopa bahamaensis Mathis and Wirth, new species
fig. 4

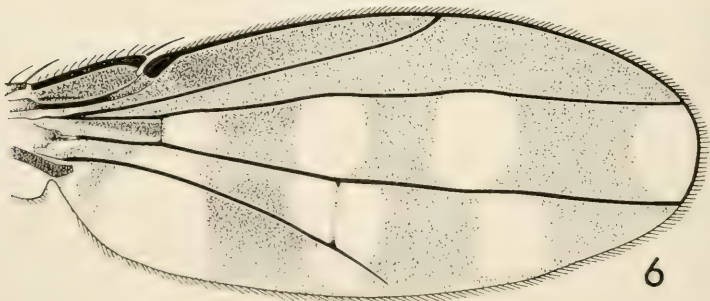
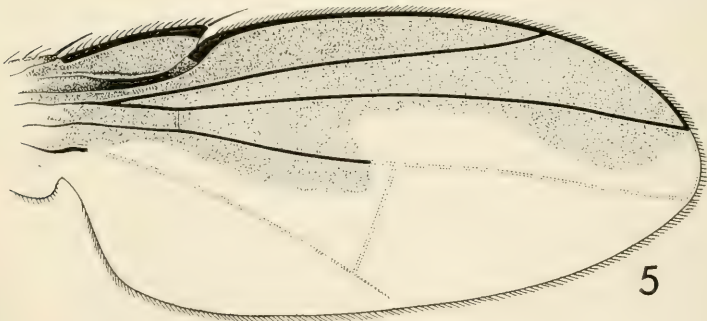
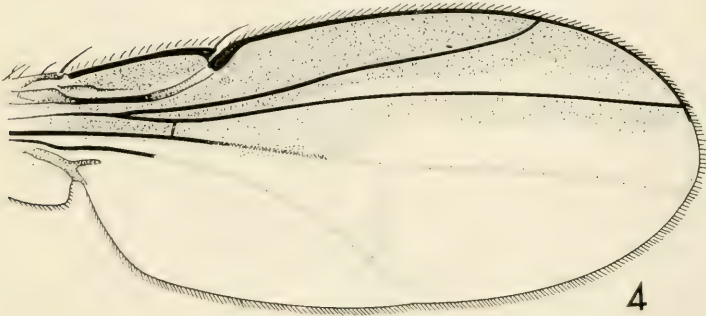
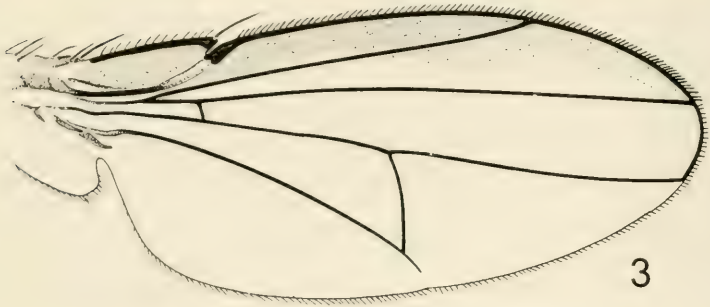
Diagnosis: *Nesopsilopa bahamaensis* is similar to *N. caeruleiventris* but can be distinguished from it and other congeners by the following characters: Length 3.5 mm; ocellars inserted laterad of anterior ocellus; antennal arista with 8-9 branches; face wide, head-width to face-width ratio 1 : 0.42; 4 pairs of larger facial bristles, uppermost pair well above middle of face and distinctly separated from remaining facials; parafacies moderately narrow, enlarging slightly along ventral margin of eye, eye to cheek ratio 1 : 0.13; anterior margin of wing infuscated, brown, posterior margin of infuscation indefinite, blending gradually with hyaline posterior half of wing; maculation pattern as in fig. 4; hind crossvein whitish; costal vein index 1 : 0.51; M1 + 2 vein index 1 : 0.90; scutellum concolorous with mesonotum; abdomen bluish-black, shining, metallic.

Type and Type-locality: Female holotype: "Grand Bahama Isl., West End, May 12, 1953; Van Voast—A.M.N.H., Bahama Isls. Exped., Coll. Hayden, Giovannoli & Rabb; HOLOTYPE *Nesopsilopa bahamaensis* Mathis and Wirth [red]." The holotype will be deposited in the American Museum of Natural History, New York.

Nesopsilopa stonei Mathis and Wirth, new species
fig. 1, 13-14

Diagnosis: This species is closely related to *N. caeruleiventris* on the basis of overall similarity and can be distinguished from that species as follows: Length 2.92 mm (holotype), less robust species; ocellars arising laterad or very slightly caudad of alignment of anterior ocellus; antennal arista with 7-9 branches; face narrow, head-width to face-width ratio 1 : 0.31; 4 pairs of larger facial bristles, the uppermost pair located above middle of face and well separated from lower pairs; parafacies very narrow, linear, eye to cheek ratio 1 : 0.07 (holotype); anterior margin of wing infuscated, dark brown; hind crossvein whitish; costal vein index 1 : 0.62; M1 + 2 vein index 1 : 0.71; abdomen shining with metallic bluish-black reflections; male genitalia as in fig. 13-14.

Types and Type-locality: Male holotype: "Petionville, 1000 ft., Haiti; WBHeed, HLCarson, Jun Jul 1959; HOLOTYPE *Nesopsilopa stonei* Mathis & Wirth [red]." Allotype: "Guajataca Forest, Isabela,



Figs. 3-6, wing. 3, *Nesopsilopa umbrosa*. 4, *Nesopsilopa bahamaensis*. 5, *Nesopsilopa caeruleiventris*. 6, *Guttipsilopa haydeni*.

P R (Puerto Rico), 22 July 1955. Collected at light.; Ramos & Maldonado Collectors; ALLOTYPE *Nesopsilopa stonei* Mathis & Wirth [red]. The holotype and allotype are in the National Museum of Natural History, Washington, D. C., type number 74003.

Remarks: It is our distinct privilege to name this new species after Alan Stone, eminent dipterist, abettor, and friend.

Nesopsilopa umbrosa (Loew), NEW COMBINATION

fig. 2-3, 9-10

Psilopa umbrosa Loew, 1862:143.

Rhysophora umbrosa (Loew); Cresson, 1946:152 (as *unbrosa*); Wirth, 1968:12.

Diagnosis: This species resembles *Nesopsilopa* species A but is distinguished from it and other congeners by the following characters: Length 2.73-3.06 mm; ocellars arising slightly cephalad of anterior ocellus; antennal arista with 5, sometimes 6, branches; face wide, head-width to face-width ratio averaging 1 : 0.40, lower $\frac{1}{2}$ with slight prominence; 3-4 pairs of larger facial bristles, upper pair just below middle of face; parafacies narrow although wider than in *N. stonei*; eye to cheek ratio averaging 1 : 0.20; wing (fig. 3) infusate in only 1st and 2nd marginal cells, light brown; costal vein index averaging 1 : 0.67; M1 + 2 vein index averaging 1 : 0.68; abdomen subshining to shining, blackish brown; male genitalia as in fig. 9-10.

Type and Type-locality: Female holotype: "Cuba. [green]; Loew Coll.; umbros.; Type 1144 [red]; *Nesopsilopa umbrosa* (Loew), Mathis & Wirth, 1977." The holotype is in the Museum of Comparative Zoology, Harvard University.

Remarks: This is the only "common" species of the genus. Data for specimens that we have examined are as follows:

United States: Florida: Monroe Co., Boca Chica, 10 x 70, 29 xii 70, 23 i 71, 27 vi 71, 18 vii 71, W. H. Pierce (3♂, 6♀; FSCA, USNM); Saddlebunch Keys, 20 xii 53, H. V. Weems (3♀; FSCA, USNM); Dade Co., Everglades Nat'l Pk., 8 iii 55, H. A. Denmark (1♂; FSCA).

Bahamas: Cat Island, The Bight, 22 iii 53, Hayden and Giovannoli (1♂; AMNH). Mayaguana Island, near Abraham Bay, 3 iii 53, Hayden (1♂, 1♀; AMNH, USNM). New Providence Island, Nassau, 5 iv 53, Hayden (3♀; AMNH, USNM), 24 ix 60, Babb (1♀; USNM).

Nesopsilopa Species A

fig. 11-12

Diagnosis: This species is very similar to and is considered the "sister-species" of *N. umbrosa*. It is distinguished from *N. umbrosa* as follows: Length 2.65 mm; face narrow, head-width to face-width ratio 1 : 0.31; costal vein index 1 : 0.55; M1 + 2 vein index 1 : 0.61; male genitalia as in fig. 11-12.

Remarks: This species is known only from a single specimen from Florida (Key West, 20 July 1939, R. H. Beamer, USNM). Fortunately,

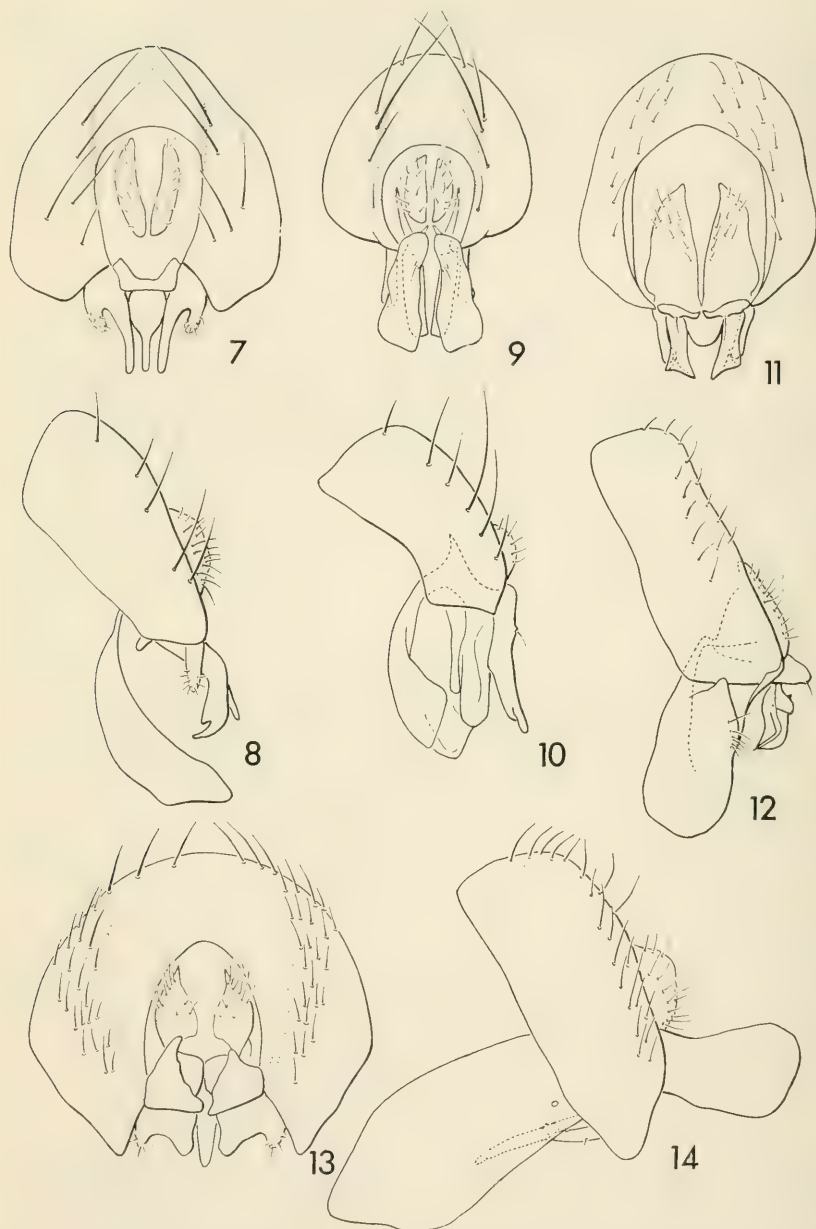


Fig. 7-14, male genitalia. 7, *Guttipsilopa haydeni*, ventral view. 8, same, lateral view. 9, *Nesopsilopa umbrosa*, ventral view. 10, same, lateral view. 11, *Nesopsilopa* species A, ventral view. 12, same, lateral view. 13, *Nesopsilopa stonei*, ventral view. 14, same, lateral view.

the only specimen is a male, enabling confirmation of its species identity by the many structural characters of the genitalia. However, we are refraining from describing it now due to its very poor general condition.

Guttipsilopa Wirth

Guttipsilopa Wirth, 1956:9. Type-species: *Guttipsilopa haydeni* Wirth, by original designation.

Diagnosis and Description: *Guttipsilopa* is distinguished from related genera of the subfamily Psilopinae by the diagnosis and description given for *Nesopsilopa* with the following additions: Length approximately 2.50 mm; wing guttate; ocellar bristles arising laterad of anterior ocellus; antennal arista with 6 branches; face narrow; 2 pairs of larger facial bristles; vein R2 + 3 short.

Distribution: *Guttipsilopa* is apparently endemic to Andros Island, Bahamas.

Natural History: Nothing is known of the immature stages nor of the habitat of the adults. The species presumably, like those of *Nesopsilopa*, inhabits seashore environments.

Guttipsilopa haydeni Wirth
fig. 6-8

Guttipsilopa haydeni Wirth, 1956:11; Wirth, 1968:8.

Diagnosis: *Guttipsilopa haydeni* is a distinctive species and is easily distinguished by the following characters: Length 2.45 mm; face narrow, head-width to face-width ratio 1 : 0.32; 2 pairs of larger facial bristles, upper pair below middle of face; parafacies very narrow throughout, eye to cheek ratio less than 1 : 0.10; wing (fig. 6) guttate, dark brown, with 4 spots in cell R4 + 5, 2nd basal spot in cell R4 + 5 extending posteriorly around posterior crossvein and into cell M3 + 4, cell M1 + 2 with additional spot near posterior wing margin; costal vein index 1 : 0.84; M1 + 2 index 1 : 0.53; abdomen shining with metallic blackish-blue reflections; male genitalia as in fig. 7-8.

Type and Type-locality: Male holotype: "Andros Island, Fresh Creek, April 23, 1953; Van Voast—A.M.N.H., Bahama Isls. Exped., Coll. E. B. Hayden & L. Giovannoli; *Guttipsilopa haydeni* Wirth HOLOTYPE."

Remarks: The type is pinned with one wing mounted separately on a slide; the abdomen has been removed for dissection of the genitalia which are in a microvial on the pin.

Key to Species of *Nesopsilopa* and to Related Genera

1. Wing guttate, generally dark except for distinct white spots 2
- Wing at most with infuscation along anterior $\frac{1}{2}$, otherwise hyaline 4

2. Postocellars reclinate; alula reduced; base of ocellar bristles aligned caudad of anterior ocellus 3
- Postocellars proclinate; alula normal; base of ocellars aligned laterad of anterior ocellus *Guttipisilopa haydeni* Wirth
3. Gena wide; arista with 8–10 branches; 1 pair of proclinate fronto-orbitals; R2 + 3 normal; supra-alar present; anal angle of wing normal, projecting *Actocetor* Becker
- Gena narrow; arista with 5–6 branches; 2 pairs of proclinate fronto-orbitals; R1 + 3 abruptly shortened and usually with stump vein; supra-alar absent; anal angle of wing not projecting *Trypetomima* de Meijere
4. Postocellars reclinate to diverging; wing hyaline; reclinate fronto-orbital laterad of larger proclinate fronto-orbital *Clasiopella* Hendel
- Postocellars proclinate; anterior margin of wing infuscated; reclinate fronto-orbital caudad of larger proclinate fronto-orbital *Nesopsilopa*, new genus.... 5
5. Abdomen shining, metallic bluish black; anterior margin of wing very dark, dark brown; posterior crossvein whitish; arista with 8–9 branches 6
- Abdomen subshining to shining, brownish black; anterior margin of wing only slightly darkened, light brown; posterior crossvein brownish; arista with 5–6 branches 8
6. Face relatively wide, head-width to face-width ratio averaging 1 : 0.39; costal vein index 1 : 0.47; larger species, length 3.5–4.0 mm 7
- Face relatively narrow, head-width to face-width ratio averaging 1 : 0.31; costal vein index 1 : 0.62; smaller species, length 3.0 mm *Nesopsilopa stonei*, new species
7. Scutellum dark brown; posterior margin of wing infuscation sinuate, distinct *Nesopsilopa caeruleiventris* (Loew)
- Scutellum concolorous with mesonotum, gray; posterior margin of wing infuscation indefinite, blending gradually with hyaline area *Nesopsilopa bahamaensis*, new species
8. Face relatively narrow, head-width to face-width ratio 1 : 0.31; costal vein index 1 : 0.55; smaller species, length 2.65 mm *Nesopsilopa* species A
- Face relatively wide, head-width to face-width ratio 1 : 0.40; costal vein index 1 : 0.67; larger species, length 2.73–3.07 mm *Nesopsilopa umbrosa* (Loew)

GENERAL DISCUSSION

The tribal classification of the genera herein considered is as yet unresolved. The present distinguishing characters, used either singly or together, cannot be universally applied. Cresson (1942) erected the tribes Discocerini and Psilopini in his key to the North American species of Psilopinae. Psilopini was distinguished from Discocerini by the following characterization:

“Ocellars situated caudad of line of anterior ocellus, sometimes between the posterior ocelli, far caudad of line of frontals and frontorbitals (the latter sometimes weak); antennae generally of the complex Notiphiline type; mostly shining to polished species.”

Guttipsilopa and some *Nesopsilopa* agree with Cresson's definition of Psilopini in the first two characters but these genera are pollinose over much of the dorsal surface. However, *Nesopsilopa umbrosa* does not agree in any of the characters. The basal insertion of the ocellars is aligned cephalad of the anterior ocellus, arisal branches average 5 (Gymnopine type), and the mesonotum and head are densely pollinose.

Both *Guttipsilopa* and *Nesopsilopa* belong to an assemblage of genera, including Psilopini (sensu Cresson) that can be distinguished from the "Discocerini" by the well-developed prescutellars which are widely separated, and well forward (approximately in line or anterior to the alignment of the intra-alars). Further, most genera of "Psilopini" (group A) are recognizable by the larger proclinate fronto-orbital being laterad of the reclinate fronto-orbital; by the sparsely setulose disc of the scutellum; by the reduced or absent postocellars, which if present are lateroclininate; and by the lack of a supra-alar. The remaining genera (group B) of this assemblage resemble the "Discocerini" and can generally be characterized by the following: Reclinate fronto-orbital behind larger proclinate fronto-orbital; postocellars relatively large, proclinate-diverging; scutellum setulose; and dorsum of the thorax and head densely pollinose. However, several genera of the assemblage possess character states of both groups, i.e. *Rhysoptera*, *Trypetomima*, and *Clasiopella*. We feel that these genera as well as most of the genera of the assemblage are valid, being recognizable by derived character states, but the groupings of genera are unsatisfactory. Which character states are the result of convergences, reversals, etc. are unsettled questions.

Discocerini and Psilopini must either be characterized again, using discrete characters and/or perhaps with different generic complements, or the two tribes should be combined. We favor the latter, but reserve a more definitive judgement until the entire complex can be studied thoroughly, especially their male genitalic characters.

We express our grateful appreciation for the cooperation of the following curators and their respective institutions for the loan of specimens: Ms. Margaret Thayer, Museum of Comparative Zoology, Harvard University (MCZ); Dr. Howard V. Weems, Jr., Florida State Collection of Arthropods, Division of Plant Industry, Gainesville, Florida (FSCA); and Dr. Pedro W. Wygodzinsky, American Museum of Natural History (AMNH). The drawings were made by Mr. Michael L. Druckenbrod.

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TWO NEW NEOTROPICAL FRUITFLIES OF THE GENUS *ANASTREPHA*, WITH NOTES ON GENERIC SYNONYMY (DIPTERA, TEPHRITIDAE)

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ABSTRACT—*Lucumaphila* Stone, *Phobema* Aldrich, and *Pseudodacus* Hendel are synonymized under *Anastrepha* Schiner. Descriptive notes on *Anastrepha atrox*, n. comb. from *Phobema* are given. *Anastrepha nunezae* (Colombia; host, *Matisia cordata*, family Bombacaceae) and *A. stonei* (Bahamas; host unknown) are described.

Since the publication of the still unsuperseded revision of the genus *Anastrepha* by Stone (1942a), Stone himself has described 7 and others have described 22 additional new species. No species has so far been given a name commemorative of my esteemed friend Alan Stone's exemplary work on the genus. I take this opportunity to describe *Anastrepha stonei*, taken in a McPhail trap in a guava tree in the Bahamas, as well as to provide a name, *A. nunezae*, for another new species which is a pest of the fruit known in Colombia as zapote and which is botanically *Matisia cordata* Humboldt and Bonpland, of the family Bombacaceae. This tree, according to Camargo (1969), is cultivated "por sus agradables frutos, muy ricos en vitaminas."

I wish to thank the authorities of the Estacion Experimental Agricola "La Molina," La Molina, Peru for the specimens whose study resulted in the synonymy of *Phobema*; Ligia Nuñez Bueno and the authorities of the Instituto Colombiano Agropecuario, Bogotá, Colombia for the series of excellent specimens of *A. nunezae*; and Richard P. Higgins, Plant Protection Quarantine Officer at Miami, Florida, for his alertness in bringing to my attention the specimens of *A. stonei*.

Genus *Phobema* Aldrich

Phobema Aldrich, 1925: 7. Type of genus, *P. atrox* Aldrich, by original designation. New Synonym of *Anastrepha*.

In his catalogue of the Neotropical species of Tephritidae, Foote (1967) followed Aczél (1954) in recognizing *Phobema* as a distinct genus in a "group I" of the Trypetini, including also *Anastrepha*, *Cryptodacus*, *Lucumaphila*, and *Pseudodacus*. The only character cited by both Aldrich and Aczél for distinguishing *Phobema* from other genera in the group is the development of a protuberance between and a little above the antennae. Several species of

¹ c/o U.S. National Museum, Washington, D.C. 20560.

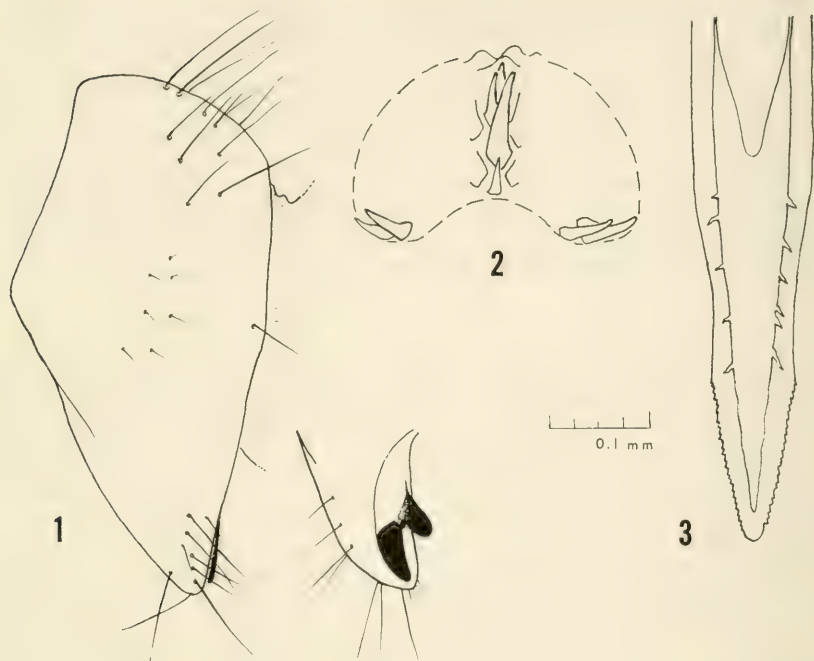


Fig. 1-3, *Anastrepha atrox*. 1, epandrium, lateral view with posterior view of left process and prensisetae. 2, rasper, showing extreme lateral and median hooks. 3, ovipositor tip. Scale applies to Fig. 2 and 3.

Anastrepha have special developments on the lower face, and at least in *A. gigantea* Stone and *A. pallidipennis* Greene a ridge extends between the antennae to a somewhat greater extent than in other species of the genus. Such a single apomorphic character is insufficient to characterize a genus. In all other respects, *Phobema atrox* is very much like several species of *Anastrepha*, especially *A. gigantea* Stone (1942b), from which it may be distinguished as follows:

Wing 11.5-12 mm long, with sharply demarcated hyaline triangle or wedge just apicad of tip of R_1 ; V-band only tenuously connected along R_5 with S-band; facial ridge straight in profile and extending dorsad between and a little above antennae as distinct protuberance; female postabdomen as in figs. 1-3, ovipositor 11.8 mm long, tip finely serrate

..... *Anastrepha atrox* (Aldrich), n. comb.

Wing 13.5 mm long, with indistinctly defined pale area apicad of tip of R_1 ; V-band joining S-band in cell R_3 ; facial ridge strongly protuberant and convex in profile, but not forming protuberance between antennae; ovipositor 9.0 mm long, tip non-serrate, but with pair of small lateral swellings.....

..... *Anastrepha gigantea* Stone

Anastrepha atrox was originally described from Baños, Oriente (now Tungurahua), Ecuador. The type and specimens from La Molina (near Lima), Peru are in the U.S. National Museum.

Genera *Lucumaphila* Stone and *Pseudodacus* Hendel

Pseudodacus Hendel, 1914a: 97; (1914b: 13), as subgenus. Type, *Anastrepha daciformis* Bezzi, by original designation. *New Synonym of Anastrepha*.
Lucumaphila Stone, 1939a: 340. Type, *L. sagittata* Stone, by original designation. *New Synonym of Anastrepha*.

The new species *Anastrepha stonei*, described herein on a further page, could perhaps be placed in the taxon *Pseudodacus*, which is currently regarded as of generic rank, on the basis of its lacking or having only weakly developed posterior upper fronto-orbital seta. However, at least 2 species of *Anastrepha*, *A. balloui* Stone and *A. grandis* (Macquart), the former apparently regularly and the latter often, lack this seta. Moreover, the holotype and the left side of the paratype of *A. stonei* have minute but distinct posterior upper fronto-orbitals. The wing pattern of *A. stonei* differs considerably from those of the species that Stone (1939b) included in his revision of *Pseudodacus*. In view of this, I would regard *Pseudodacus* as certainly of no more than subgeneric rank, and because the characters distinguishing *Lucumaphila* from *Anastrepha* are only in the post-abdomen and of degree, I would also regard that genus in the same way. If *Pseudodacus* and *Lucumaphila* are to be considered of generic or even of subgeneric rank, then a few other groups in *Anastrepha* should also be recognized. It seems to me to be both more consistent and of greater practicality in maintaining an easily recognizable group to consider all of these related groups with upcurved distal end of wing vein M as members of one genus, *Anastrepha*.

Anastrepha nunezae Steyskal, new species

fig. 4-10

Face concave, without median ridge.

Mesoseutum (less scutellum) 2.4 to 2.7 mm long, uniformly pale tawny to whitish; metanotum not darkened laterally. Macrochaetae black; pile yellowish. Sternopleural bristle well developed, nearly as long as, but much thinner than mesopleural bristle. Wing 6.9 to 8.4 mm long; length from bottom of alular sinus / greatest width 2.03 to 2.1 (that of *A. greeni* from published photograph 1.92); bands yellow and brownish as in most species of *Anastrepha*; costal and S-bands evenly and widely separated, proximal margin of oblique part of S-band evenly arcuate; yellow color in fork of Rs (Fig. 8) with yellow-hyaline interface approximately as long as side against R₅; median part of R₅ slightly more sinuate than in *A. greeni*; 1st costal cell and posterior 1/2 of 2nd costal cell (except yellow part near h crossvein) destitute of microtrichiae; anal lobe with large group of microtrichiae in about 5 rows near margin; 2nd basal cell with preapical

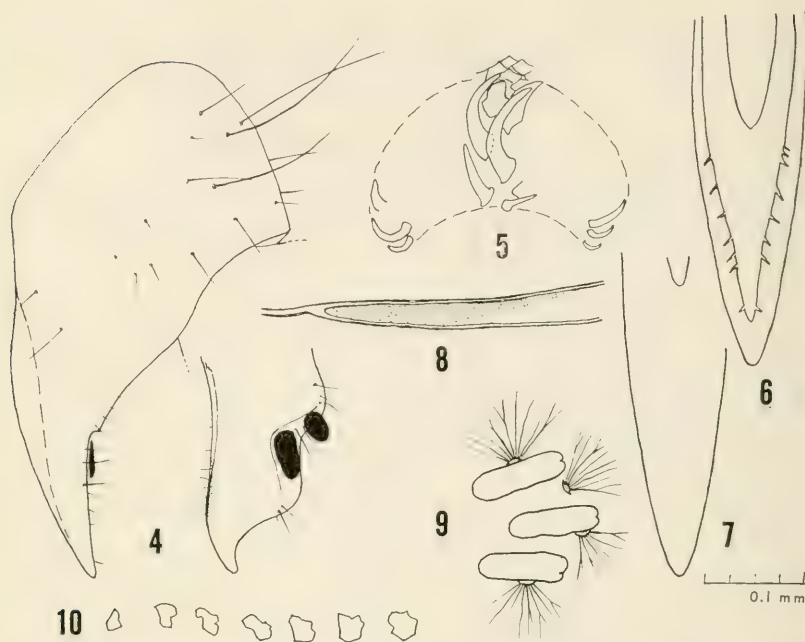


Fig. 4-10, *Anastrepha nunezai*. 4, epandrium, lateral view with posterior view of left process and prensisetae. 5, rasper, showing extreme lateral and median hooks. 6, ovipositor tip (holotype). 7, idem (outline of paratype). 8, fork of vein Rs with yellow area stippled. 9, larva, right posterior spiracle in horizontal position. 10, idem, median group of dorsal plaques on 3rd postspiracular ring. Scale applies to Fig. 5-10.

band of microtrichiae (cell otherwise bare) becoming quite sparse or absent in anterior $\frac{1}{2}$ of cell.

Female postabdomen: Ovipositor sheath 3.8 to 4.3 mm long, straight, parallel-sided in apical $\frac{1}{4}$, remainder evenly tapering to twice apical diameter at base; spiracles 1.15 mm from base. Rasper well developed, with slender hooks in about 6 rows (Fig. 5). Ovipositor 3.75 to 4.3 mm long, 0.12 mm wide, expanded but little at base, tip 0.25 to 0.3 mm long, non-serrate (Figs. 6, 7).

Male postabdomen: Epandrium as in Fig. 4, apical extension somewhat thicker and shorter than in *A. greeni*.

Mature larva: Creamy white; 10 mm long $\times$ 1.9 mm greatest diameter; Anterior spiracle with 20 to 22 papillae in concave row recurved at each end; posterior spiracles as in Fig. 9, each slit nearly 0.1 mm long, sun-ray hairs inserted in very small base. Mouthhooks and cephalopharyngeal skeleton not distinctive. Buccal folds 13 to 15. Dorsal spicules present but minute on anterior margins of 1st and 2nd segments behind anterior spiracles; 3rd segment with band of irregularly shaped light brown plaques (Fig. 10); following segments with similar rows of plaques, less distinct and more elongated in outline; and most segments also with 2 lateral longitudinal rows of 5 to 6 such plaques,

sometimes not easily distinguishable. Ventral spicules brown, up to 40 microns in length, in several rows on well-developed "creeping welts" on all segments and around anal plate, which consists of a pair of light brown semiglobular domes connected by oblong base slightly constricted at median slit. Posterior end evenly rounded, tubercles not evident, but shallow, linear, transverse impressions about height of posterior spiracular areas both above and below latter and similar shorter impression at each side of them.

Holotype (female), allotype, and paratypes (5 of each sex), Cachipay, Departamento de Cundimarca, Colombia, 10 December 1973 (L. Nuñez), reared from fruit of *Matisia cordata* HB; 13 ♀, 10 ♂ paratypes, same locality, 26 November 1974 (L. Nuñez), trap in host tree; 1 ♀ paratype, same locality, 22–29 May 1973 (H. E. Martin), trap in host tree. Except for 6 paratypes of each sex, the type series is deposited in U. S. National Museum under type No. 73807.

I am very pleased to name this species for Ligia Nuñez Bueno in recognition of her outstanding service in rearing and providing the excellent type-series of this new pest.

Anastrepha nunezae is very similar to *A. greenei* Costa Lima, described from the State of Bahia, Brazil, and reared from fruit of *Quararibea turbinata* and *Q. penduliflora*. Neither of these species of *Quararibea* is known to occur in Colombia. The female post-abdomen of *A. greenei* is evidently like that of *A. nunezae* in dimensions and conformation, but I believe that the difference in hosts, broad separation of localities, and the following morphological differences justify considering the 2 species as distinct.

Proximal margin of S-band stepped; R_3 slightly sinuate; yellow area in fork of R_s with yellow-hyaline interface much less oblique than in <i>A. nunezae</i> and much shorter than side against R_5 ; length of wing/breadth 1.92; prong of epandrium slender	<i>A. greenei</i> Costa Lima
Proximal margin of S-band evenly arcuate; R_3 somewhat more sinuate; yellow area in fork of R_3 with strongly oblique yellow-hyaline interface that is approximately equal in length to side against R_5 ; length of wing/breadth 2.03 to 2.1; prong of epandrium broader, tapering to tip	<i>A. nunezae</i> , n. sp.

Anastrepha stonei Steyskal, new species
fig. 11–14

Male. In minute or absent posterior fronto-orbital seta and very short aedeagus, related to species included in *Pseudodacus*, herein synonymized with *Anastrepha*, but differing from them most conspicuously in body and wing markings.

Length of wing 4.6–4.8 mm. Body largely creamy whitish, color pattern (see Fig. 12) including the following orange areas: acrostichal, dorsocentral, and supra-alar stripes (6, longitudinal); basal $\frac{1}{2}$ of scutellum; metanotum; lower part of sternopleuron, and most of legs; also with following black marks: oval spot on cheek at lowest extremity of eye; narrow cuneate mark on upper frontal

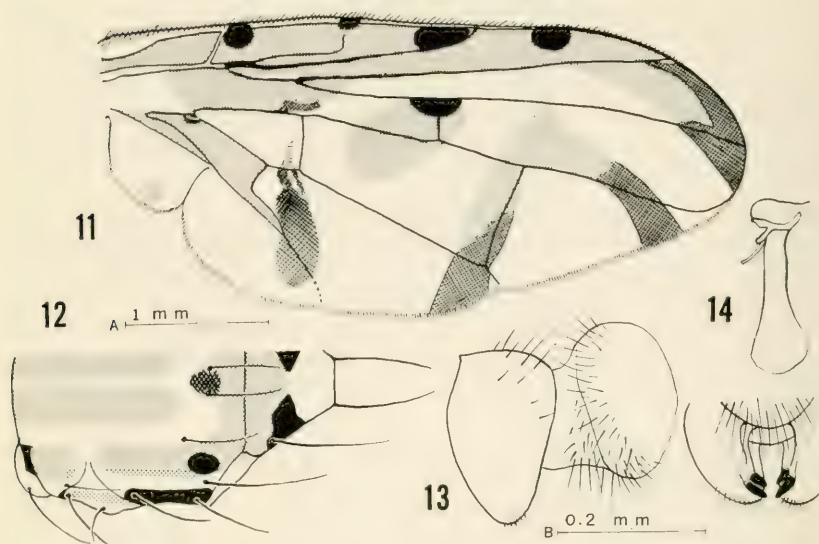


Fig. 11-14, *Anastrepha stonei*. 11, wing. 12, color pattern and bristles of meso-scutum and scutellum. 13, postabdomen of male, lateral view with posterior view of processes and prensisetae. 14, sperm pump. Scale A applies to Fig. 11-12, scale B to Fig. 13-14.

orbits not including base of bristles; ocellar triangle; mesoscutal marks as in Fig. 12; small roundish spot near wing on postalar declivity; triangular or V-shaped mark in middle of postscutellum; 3 roundish spots on mesopleuron (1 each in upper corners and 1 in lower corner); dumbbell-shaped mark on pteropleuron below seta; rather irregular mark on hypopleuron before halter and above spiracle; tip of hindtibia; pair of transverse bands (each separated mesally by space about equal to $\frac{1}{2}$ length of tergum and each $\frac{1}{2}$ also more or less separated into 2 bars) on terga 2 through 5 near anterior margins, nearly attaining lateral margins, and on tergum 5 broadly expanded laterally.

Wing pattern as in Fig. 11, costal band largely orange, with dark brown spots in base of 2nd costal cell, pterostigma, middle of cell R_1 , and at tip of vein R_5 ; well-developed V-mark present, becoming dark brown toward posterior margin of wing; S-band represented by apical part of costal seam, isolated oblique mark on and near crossvein ta , and coloration in an apicad of anal cell.

Chaetotaxy: all setae and hairs black, except fine white hairs on humerus and propleuron; head with 3-4 convergent lower fronto-orbitals, 1 reclinate (anterior) upper fronto-orbital, 1 fine and weak posterior upper fronto-orbital (lacking on dextral side of paratype), 1 fine ocellar hardly longer than length of ocellar triangle, 1 fine postocellar, 1 each inner and outer vertical; thorax with 1 humeral, 2 notopleurals, 1 sublateral, 1 supra-alar, 2 postalars, 1 acrostichal, 1 dorsocentral, 2 scutellars, 2 posterior upper mesopleurals, 1 strong pteropleural, 1 very fine sternopleural.

Postabdomen (Fig. 13) short; ventral processes blunt, with pair of stout

prensisetae on each process close to tip; aedeagus small, little sclerotized, not extending beyond end of processes; sperm pump as in Fig. 14.

Holotype and 1 paratype (males), Nassau, Bahama Islands, September 1976 (C. Smith), in McPhail trap in guava tree; type no. 73806 in U.S. National Museum.

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REVIEW OF THE HAWAIIAN *DROSOPHILA* (*ANTOPOCERUS*) HARDY¹

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ABSTRACT—The following new species of *Drosophila* (*Antopocerus*) are described from Hawaii: **kaneshiroi**, **yooni**, **curvata**, **nigricolor**, **apicalis**, and **stigma**. A key to species of *Drosophila* (*Antopocerus*), based on males, is included.

The *Antopocerus* taxon was first set up as a new genus endemic to the Hawaiian Islands. It is differentiated from other *Drosophilinae* by the unusual secondary sexual characters peculiar to the males: By having the first antennal segment comparatively large, porrect, extending well beyond margin of front and the arista with numerous, closely placed hairs along the dorsal margin and the ventral margin devoid of setae (fig. 1). Also the ornamentation and development of the front tibia and tarsus of the males is distinctive from other *Drosophila* (fig. 6–19); the anterior surface of the front tibia is flattened and bare of setae, this character seems to be unique to *Antopocerus*. Somewhat similar types of leg ornamentation are present in some other Hawaiian *Drosophila*, but not in the same combination of characters.

The illustrations were made by John W. Grubb, University of Hawaii. Dr. K. Y. Kaneshiro, University of Hawaii, had considerable input into this study and I greatly appreciate his valuable help.

From the detailed information now available concerning the genetics, behavior, ecology and other aspects of various groups of Hawaiian drosophilids it is clear that the secondary sexual characters which have resulted from selection pressures brought on by changes in mating behavior are often completely unreliable in determining relationships and certainly are not of generic or in most cases even of subgeneric importance. As demonstrated by Kaneshiro (in press) these characters found only in the males are probably of not more than species group importance. These conclusions are supported by chromosome analysis as well as by the courtship behavior studies.

Spieth (1968) pointed out that the pattern of courtship behavior displayed by the *Antopocerus* species clearly indicates close relationship to other Hawaiian *Drosophila*; these share in common a number of distinctive behavioral elements. Also Yoon, *et al.* (1972) and Yoon and Richardson (in press) have shown a high degree of cyto-

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genetic convergence between *Antopocerus* and *Drosophila* and the two must be considered congeneric. Since there are distinctive morphological features which will clearly differentiate these and no known intermediates or direct intergrades with other *Drosophila* it is best, for convenience sake, to treat *Antopocerus* as a subgenus.

From the evidence obtained by comparisons of the male genitalia, the internal anatomy (Throckmorton, 1966), the leaf breeding habits (Heed, 1971) and the courtship and mating behavior (Spieth, in conversation) this group is phylogenetically close to, and probably derived from, one of the modified tarsi groups. The *Antopocerus* evolved on Maui Nui (Maui-Molokai-Lanai group of Islands), and radiated out to Hawaii and Oahu. Fifteen species are now known; ten from Maui Nui, four from Hawaii, and one from Oahu. The group is not represented on the island of Kauai.

Spieth (1966) found the species which he studied fit into three distinct groups, based upon male courtship patterns. These correspond to the species groups which we have set up and also, for the most part, to the groupings of Yoon and Richardson (1976) based upon chorosome analysis.

The species are arranged in the following groups: *Adunca*, *diamphidiopoda* and *villosa*.

Key to Species of *Drosophila* (*Antopocerus*), Based Upon Males

- 1 Front basitarsus with very long, posterior, preapical bristle, which extends beyond apex of tarsus; also with clump of erect, moderately long, dorsal hairs occupying 2nd tarsomere and apex of basitarsus (fig. 7). 2
- Basitarsus lacking such a bristle or as above. 5
- 2(1) Front tibia with long, curled, conspicuous hairs (fig. 6-8). 3
- Front tibia lacking long hairs (fig. 9). Hawaii *tanythrix* (Hardy)
- 3(2) Front tibia with 6-7 long, ventral hairs and at least 3 dorsals (fig. 7-8). 4
- Front tibia with only 3 ventral and no long dorsal hairs (fig. 6). Hawaii *yooni* new species
- 4(3) Front tibia with 8-10 long hairs extending along entire dorsal margin (fig. 7). Hawaii *cognata* Grimshaw
- Front tibia with only 3, or sometimes 4, dorsal hairs arranged near middle of segment (fig. 8). Molokai, Maui, Lanai *diamphidiopoda* (Hardy)
- 5(1) Front tibia lacking long hairs, except for 1 anterior at apex in *longiset*a (fig. 19). Basitarsus subequal in length to tibia; 2nd tarsomere longer than 3rd (fig. 18-19). 6
- Tibia with long, conspicuous hairs, usually as long as basitarsus. Basitarsus usually about $\frac{1}{2}$ as long as tibia. Second tarsomere rudimentary, shorter than 3rd (fig. 17). 7
- 6(5) Wing expanded on apical $\frac{1}{2}$, costa arcuate beyond middle so wing is broadest beyond m crossvein. Front tibia with an apical, anterior

- hair (fig. 19). Second tarsomere 2 times 3rd and $\frac{1}{3}$ as long as basitarsus. Molokai *longiseta* Grimshaw
- Wing normal in shape. Tibia lacking apical hair. Second tarsomere just slightly longer than 3rd (fig. 18). Maui *adunca* (Hardy)
- 7(5) Wings hyaline, with brown spot at apex (fig. 24). 8
- Wings subhyaline to uniformly faintly brownish fumose; no brown markings. 9
- 8(7) Thorax all brown, tinged with red in ground color. Wing spot filling apices of cells R_1 , R_3 and R_5 and sometimes extending into upper apex of cell 2nd M_2 (fig. 24). Molokai *stigma* new species
- Thorax yellow, with broad, brown, median vitta the full length of mesonotum and over disc of scutellum; plus narrower brown vitta on each side behind humerus, extending almost to postalar bristles, interrupted at suture. Apical brown mark smaller, confined to apex of R_3 and upper $\frac{1}{2}$ of R_5 (fig. 23). Maui *apicalis* new species
- 9(7) Basitarsus not with dense clump of black hairs near base. Hairs of dorsal portion of tibia much shorter than those on venter. 10
- Basitarsus with fascicula of long, anterodorsal hairs near base. Tibia with long, black villose hairs on both ventral and dorsal surfaces (fig. 12-13). 13
- 10(9) Costa gently convex, arched beyond middle so wing is broadest beyond m crossvein. Front tibia with numerous long, ventral and posterior hairs extending full length and lacking clump of anterior hairs at apex. No clump of hairs at apex of basitarsus and 2nd tarsomere. Fourth tarsomere not lobate (fig. 14, 15, 17). 11
- Costa straight, anterior and posterior margins of wing almost parallel sided. Tibia not with rows of hairs extending full length of segment. Hair clump present at apex of basitarsus and on 2nd tarsomere; 4th lobate at apex (fig. 10 and 11). 14
- 11(10) Tarsi with prominent long hairs (fig. 14 and 17). 12
- Tarsi lacking long hairs (fig. 15). Maui *entrichocnema* (Hardy)
- 12(11) Thorax mostly brown, with rather distinct vittae on mesonotum. Front basitarsus elongate, subequal in length to tibia. Tibia strongly curved. Ventral hairs of front tibia very long compared to short posterior hairs. Basitarsus with strong posterodorsal hair and with other hairs as in fig. 17. Kipahulu, Maui *curvata* new species
- Mostly yellow species. Basitarsus about $\frac{1}{2}$ as long as tibia. Tibia nearly straight, dorsal row of hairs longer than ventral hairs. Basitarsus with row of moderately long, dorsal cilia from near base to apex and another row of posterodorsals over apical $\frac{3}{4}$ (fig. 14). Oahu *arcuata* (Hardy)
- 13(9) Thorax mostly yellow to rufous, with 3 brown longitudinal vittae on mesonotum. Fascicula on front basitarsus consisting of about 12 closely placed, long, black hairs (fig. 12). Maui *villosa* (Hardy)
- Thorax nearly all subshining black, mesonotum not distinctly vittate. Fascicula on front basitarsus consists of 5 hairs (fig. 13). Molokai *nigricolor* new species
- 14(10) Mesonotum with pair of brown longitudinal vittae. Mesopleuron and upper pteropleuron brown. Only 2 ventral hairs on front tibia,

- these much shorter than dorsal hairs; latter are arranged from basal $\frac{1}{4}$ – $\frac{1}{5}$ to about apical $\frac{2}{5}$ of tibia (fig. 10). Maui *orthoptera* (Hardy)
- Mesonotum and pleura all yellow. Tibia with 5 ventral hairs, these equal in length to dorsal hairs; latter are arranged from basal $\frac{2}{5}$ to apical $\frac{1}{5}$ of segment (fig. 11). Hawaii *kaneshiroi* Hardy

THE ADUNCA GROUP OF SPECIES

Containing the species *adunca* (Hardy), from Maui, and *longiseta* Grimshaw, from Molokai.

Differentiated by having front tibia of male devoid of long curled hairs, except for one anterior hair at apex in *longiseta* (fig. 19). Basitarsus elongate, subequal in length to tibia. Second tarsomere longer than third, remainder of tarsi normal. Wing with fuscous markings anteroapically, costal margin convex, wing widest beyond m crossvein.

As discussed by Spieth (1968), it is logical to conclude that the ancestral stock of *Antopocerus* arose in the Maui Nui complex of islands (Maui-Molokai-Lanai) less than 1.8 million years ago, and the most primitive decedents are now represented by *adunca*, from Maui, and *longiseta*, from Molokai. The courtship behavior is similar in these two and represents the most primitive pattern in the subgenus *Antopocerus*. On the basis of morphological characteristics one would have to conclude that *adunca* is the more primitive and that *longiseta* is the derived species. The *Antopocerus* characteristics of the scape of the male antenna and the modification of the front legs are fully developed in *adunca* but the arista of the antenna has short, distinctly spaced hairs along the dorsal surface (fig. 2) rather than the dense, long pilosity (fig. 3) or villosity (fig. 5) characteristic of the derived species. Also the wing is like typical *Drosophila* in shape, rather than with the costal margin arcuate beyond middle as in *longiseta*, or completely straight, as in the diaphidiopoda group of species (fig. 21). If *adunca* is considered the probable ancestral type, this would indicate that the subgenus could have evolved after West Maui was formed, 1.15–1.3 million years ago (Spieth, 1968) rather than 1.8 million years ago when West Molokai appeared.

Yoon and Richardson (1976) state that "based upon biogeographical, behavioral and cytogenetic information *A. longiseta* from Molokai is tentatively identified as the primitive species of the subgenus." However, on the basis of chromosome analysis they state that *adunca* could have been derived from or given rise to either *longiseta* or *arcuata*. The former is distinctive from both of these by having six pairs of rods in the metaphase configuration. On morphological characteristics *arcuata* would not appear to fit in the same group with *longiseta*. The courtship behavior has not been studied for this species so there is still a question as to where it correctly fits.

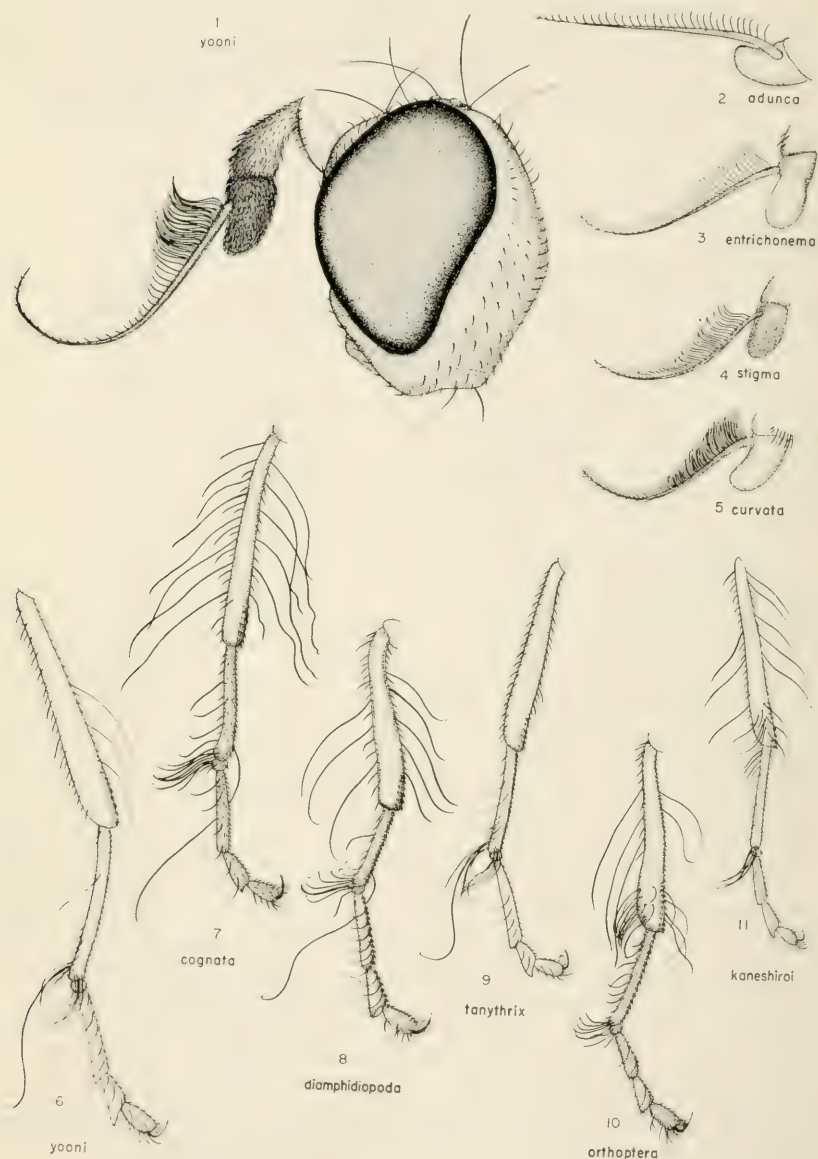


Plate 1.

Fig. 1, head of *Drosophila (Antopocerus) yooni*, lateral view. Fig. 2-5, third antennal segment and arista. 2, *adunca*. 3, *entrichocnema*. 4, *stigma*. 5, *curvata*. Fig. 6-10, front legs of males, anterior view. 6, *yooni*. 7, *cognata*. 8, *diamphidiopoda*. 9, *tanythrinx*. 10, *orthoptera*. 11, *kaneshiroi*. (Please note that the correct spelling for fig. 3 is *entrichocnema*.)

THE DIAMPHIDIPODA GROUP OF SPECIES

Containing the following species: *Cognata*, from Hawaii; *diamphidiopoda*, from Maui, Molokai and Lanai; *kaneshiroi*, from Hawaii; *orthoptera*, from Maui; *tanythrix*, from Hawaii; and *yooni*, from Hawaii.

Characterized by males having the costal margin straight, with wing comparatively narrow, the front and hind margins nearly parallel and wing broadest in median portion (fig. 21). Also the wing is evenly infuscated, faintly brownish, lacking distinct brown markings. The front basitarsus is about half to two-thirds as long as the tibia, with a very long, pre-apical, posterior bristle, except in *orthoptera* and *kaneshiroi*, extending beyond apex of tarsus (fig. 6); also with a clump of erect anterior, bristlelike hairs at end of basitarsus and on second tarsomere. Second tarsomere is rudimentary, wider than long. Third tarsomere flattened dorsally, rather elongate, subequal to length of basitarsus. Fourth tarsomere has a characteristic dorso-apical, pointed lobe (fig. 6-11). The front tibia is slightly curved on the anterior surface and usually with long curved hairs on ventral and, or, dorsal margins (fig. 6-8, 10-11).

In one of the species, *cognata*, the long dorsal hairs of the arista extend in a close set, single row to the base (as in fig. 3) while in *diamphidiopoda*, *orthoptera*, *kaneshiroi*, *tanythrix* and *yooni* the dorsal vestiture on basal portion of arista is much denser and the hairs are arranged in two or more rows (as in fig. 4-5).

It is probable that *diamphidiopoda*, from Molokai, Maui, and Lanai, is representative of the ancestral type of this group. *Drosophila orthoptera*, from Maui, was probably derived from a *diamphidiopoda*-like ancestor and differs by a reduction in the number of long hairs on the front tibia and by lacking the long apical posterior bristle on the front basitarsus (fig. 10); it then gave rise to *kaneshiroi*, from Hawaii. As pointed out by Spieth (1968) *orthoptera* and *diamphidiopoda* fit in the same group according to courtship behavior but *orthoptera* is more specialized (the behavior of *kaneshiroi* has not been studied).

It would then seem likely that *diamphidiopoda*, or a like ancestor, invaded Hawaii and evolved into *cognata*, then *yooni* and *tanythrix*; the evolutionary pattern has involved the reduction of long hairs on the front tibia (fig. 6-10). The aristae of these, except for *cognata*, are of the *longiseta* type, with two or more rows of villose hairs on basal third. Yoon and Richardson (1976) also concluded that *yooni* fits phylogenetically between *cognata* and *tanythrix*.

The *diamphidiopoda* group of species fits Spieth's courtship behavior pattern type II (1968). Yoon and Richardson (1976) in their studies of patterns and rates of chromosome evolution in the *Antopocerus* studied all of the species of the group except *orthoptera* and *kaneshiroi*. Based upon the chromosome analysis they placed these in two groups: *diamphidiopoda* and *cognata* fitting together by having homosequential polytene chromosomes but with differences in the metaphase configuration and *tanythrix* and *yooni* fitting to-

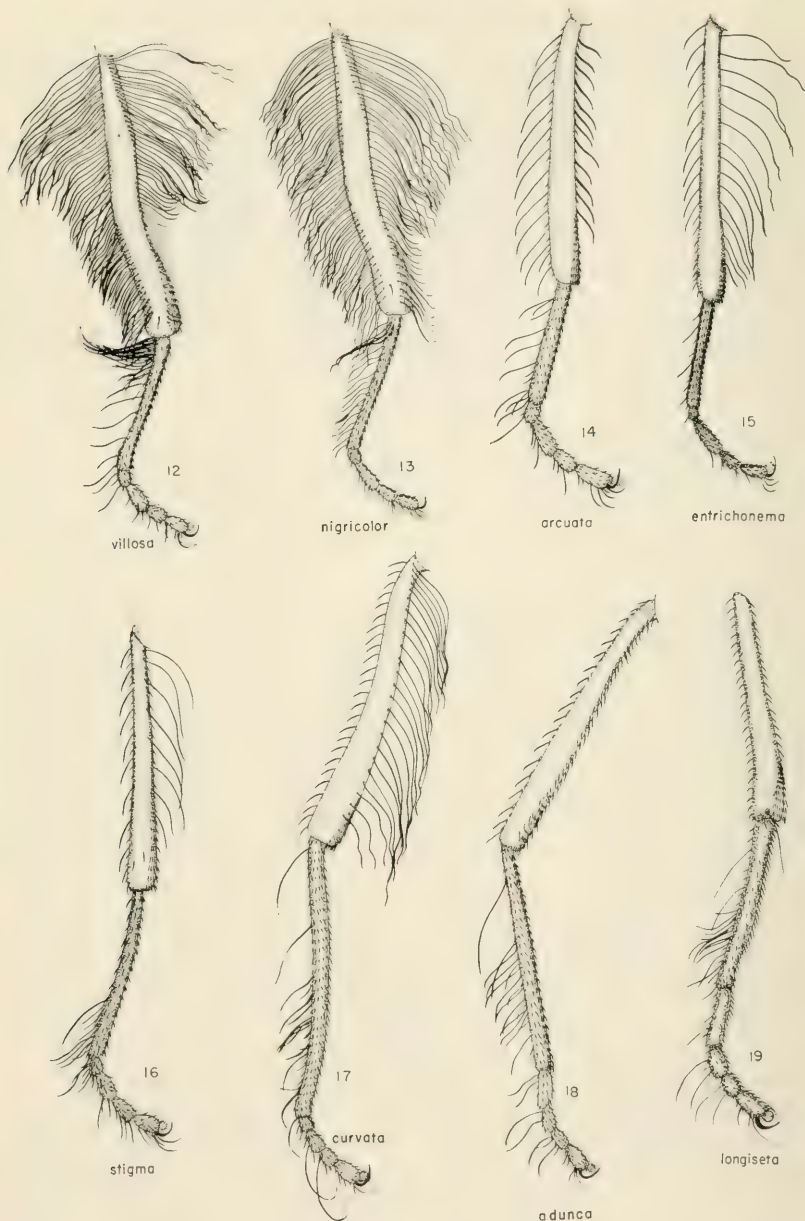


Plate 2.

Fig. 12-19, front legs of males, anterior view. 12, *villosa*. 13, *nigricolor*. 14, *arcuata*. 15, *entrichonema*. 16, *stigma*. 17, *curvata*. 18, *adunca*. 19, *longiseta*. (Please note that the correct spelling for fig. 15 is *entrichonema*.)

gether by sharing three unique inversions. They conclude that *tanythrix* and *yooni* were probably derived from *diamphidiopoda* although at present "it is not clear if these species evolved linearly, or divergently from a common ancestor."

Drosophila (Antopocerus) kaneshiroi Hardy, new species

fig. 11

Very close to *orthoptera*, from Maui, and the two form a complex of the *diamphidiopoda* group of species characterized by lacking the long, posterior, preapical bristle on front basitarsus. The only character I find for differentiating these is in the ornamentation of the front legs of the males and in the coloration of the thorax.

Drosophila kaneshiroi has the thorax all yellow, lacking brown markings. The front tibia has 5 long ventral bristles arranged from near base to apical $\frac{3}{5}$ of segment, these are equal in size to the dorsal hairs. Three dorsal hairs are arranged from just below middle to apical $\frac{1}{5}$ of segment. Front basitarsus with 3 prominent anterodorsal hairs in a row at base. Other details of the front legs as in fig. 11. *Drosophila orthoptera* is characterized by having a pair of longitudinal, submedian, brown vittae down the mesonotum and the mesopleura and upper sternopleura brown. Only 2 ventral hairs are present, situated at about basal $\frac{1}{5}$ of tibia, these are short compared to the dorsal hairs. The 3 dorsal hairs are subequal in length to the tibia and are arranged from basal $\frac{1}{4}$ – $\frac{1}{5}$ to apical $\frac{2}{5}$ of segment (fig. 10). The front basitarsus lacks the 3 basal, anterodorsal hairs present in *kaneshiroi*. *Drosophila kaneshiroi* otherwise fits the description of *orthoptera* and obviously was derived from that species.

Length of male: Body, 4.8 mm; wing, 4.55 mm by 1.35 mm width.

Female. Fitting the description of the male except for secondary sexual characters and except for a tinge of brown in the ground color of the mesonotum. The first tergum is entirely yellow and the sides and anterolateral portions of terga 2 to 4 are conspicuously pale yellow. The female wing is like typical *Drosophila* in shape.

Length: Body, 4.5 mm; wing, 5.25 mm.

This species is named after Dr. K. Y. Kaneshiro, University of Hawaii, the project coordinator for the Evolution of the Hawaiian *Drosophilidae* studies. He has worked with this project since its onset in 1963 and much of the research accomplishments have been due to his efforts and talents.

Holotype male, Manuka Forest Reserve, South Kona, Hawaii, June 26, 1976 (S. L. Montgomery). One female, same data as type, it is not being designated as a paratype because of the lack of differentiating characters in females of *Antopocerus*. Type in B. P. Bishop Museum. Female specimen in University of Hawaii collection.

Drosophila yooni Hardy, new species

fig. 1, 6, 21

This species fits in the *diamphidiopoda* group by having the costal margin straight, the front basitarsus with a very long, pre-apical, posterior bristle and fitting the other characters of this group. This species appears to fit intermediate

from *cognata* and *tanythrix* differing from the 1st by the reduction in number of long cilia on the tibia; having only 3 ventral and no long dorsals (fig. 6), rather than with 6 ventrals and 8–10 dorsals (fig. 7), and from *tanythrix* by having 3 long ventral hairs. It is obviously closely related to the latter and the 2 occur sympatrically on the island of Hawaii. The courtship behavior of *yooni* fits it in the diamphidiopoda group (Spieth, in conversation).

Morphologically *yooni* and *tanythrix* are very similar. The only character we find for differentiating these is in the development of the long ventral hairs of the front tibia of the male, the 3 hairs are evenly spaced from about middle to apical $\frac{1}{4}$ of segment and all extend to or beyond the apex of the tibia (fig. 6). In *tanythrix* the ventral hairs are poorly developed, 2 slightly curved hairs, scarcely larger than the other leg setae, are situated near the apical $\frac{1}{3}$ of segment (fig. 9).

Drosophila yooni would otherwise fit the characteristics of other species of the diamphidiopoda group of species: i.e. Head of male as in fig. 1. First antennal segment yellow, remainder dark brown, tinged with red. Thorax yellow, tinged with brown on dorsum. Wings evenly fumose shaped as in fig. 21. Front tibia and tarsus of male as in fig. 6. Abdomen mostly brown, yellow on venter and on sides and anterolateral margins of terga.

Length: Body, 4.0 mm; wing, 4.6 mm.

Female unknown.

Holotype male, upper Olaa Forest Reserve, Wright Road, Hawaii, 3,800 ft., July 25, 1975 (H. T. Spieth). Thirty-one paratypes, all males; some same data as type, and some same locality as type, June 1968 (H. L. Carson and M. P. Kambyzellis); Rangers Cabin, Kilauea, Hawaii, March 1966 (W. B. Heed); Keanakolu, Hawaii, 4,000 ft., June 1966 (W. B. Heed); and Kahuku Ranch Road, S. Kona, Hawaii, 3,800 ft., May 1976 (K. Y. Kaneshiro).

Type and series of paratypes in the B. P. Bishop Museum. Paratypes deposited in the collections of the U. S. National Museum, British Museum (Natural History), University of Texas and University of Hawaii.

It is a pleasure to name this species after Dr. Jong Sik Yoon, University of Texas, whose studies of the cytogenetics of *Antopocerus* and other Hawaiian *Drosophila* have been most important contributions to our understanding of this fauna.

THE VILLOSA GROUP OF SPECIES

Consisting of *villosa*, from Maui; *entrichocnema*, from Maui; *curvata*, from Maui, *nigricolor*, from Molokai and *arcuata*, from Oahu; also *apicalis*, from Maui and *stigma*, from Molokai, which belong in the *apicalis* complex of species.

Characterized by having long, curled, densely placed, ventral and short to long dorsal hairs extending over most of the front tibia of the male (fig. 12–17). Second tarsomere slightly longer than wide; third not modified, about two times longer than second; fourth tarsomere not lobate. Wings infuscated, faintly brownish with no distinct dark markings except in the *apicalis* complex; costal

margin convex beyond middle of wing. Mesonotum with a rather prominent broad, dark brown median vitta, except in *nigricolor* and *arcuata*. The basal portion of the arista has two or more rows of densely placed, villose hairs along the dorsum in six of the species (fig. 4-5) and a single row of closely placed hairs in *entrichocnema* (as in fig. 3). The latter may be the most primitive of this group.

The position of *arcuata* is not clear. The chromosome analysis (Yoon and Richardson, 1976) would seem to place it near *longiseta*. We cannot confirm this on the basis of morphological characters. The courtship behavior of *arcuata* has not yet been studied. The latter species is the only one of this group for which chromosome analysis has been made (Yoon and Richardson, 1976).

Drosophila curvata Hardy, new species
fig. 5, 17

Fitting the villosa group of species but readily differentiated by the ornamentation of the front legs of the male (fig. 17). It fits nearest to *arcuata*, from Oahu, based upon morphological characters but these do not appear to be related. The courtship behavior or chromosomes of *curvata* have not been studied.

Drosophila curvata differs from *arcuata* by having the thorax mostly brown with 3 dark brown vittae down mesonotum. By having front tibia of male strongly curved on anterior surface with very long hairs along ventral surface and rather short, suberect hairs along dorsal surface (fig. 17). Front basitarsus elongate, subequal in length to tibia and with prominent dorsal hair at base and with about 12 dorsal and posterior hairs on apical $\frac{1}{2}$ of segment. Second tarsomere about 2 times longer than wide and subequal to 3rd. Tarsomeres 2 to 4 each with a strong dorsal hair.

Drosophila arcuata is a mostly yellow species, lacking vittae on the mesonotum. The front basitarsus is comparatively short, about $\frac{1}{2}$ as long as tibia. The tibia is nearly straight and the hairs on dorsal surface are longer than those on ventral (fig. 14). The basitarsus has a row of moderately long dorsal hairs from near base to apex and the 2nd tarsomere is about as wide as long and scarcely $\frac{1}{2}$ as long as 3rd.

Otherwise *curvata* fits the characteristics of *villosa*, having 2 or more rows of densely placed dorsal hairs on basal $\frac{1}{3}$ of arista (fig. 5); wings evenly brownish fumose and costal margin distinctly arcuate as in fig. 20.

Length: Body 5.8 mm; wings, 6.3 mm.

Female unknown.

Holotype male and one male paratype, Kipahulu Valley, Maui, 3,100 ft., August 5-10, 1961 (K. Y. Kaneshiro). Type in B. P. Bishop Museum, paratype in University of Hawaii collection.

Drosophila nigricolor Hardy, new species
fig. 13, 22

Fitting close to *villosa*, from Maui, and the only characters we find for separating these is the body coloration and the ornamentation of the front legs. In *villosa* the thorax is typically yellow to rufous with 3 brown, longitudinal vittae on mesonotum and with a tinge of brown over the disc of the scutellum; also

a faint tinge of brown often present over median portion of mesopleuron and upper pteropleuron. The thorax of *nigricolor* is mostly shining black, lightly brownish pollinose over the dorsum, gray on sides. In the type the mesonotum is entirely black, except for a faint tinge of red in the ground color on the anterior portion above each humerus. The scutellum is entirely black and most of the mesopleuron and upper pteropleuron are black. The sternopleuron, metapleuron and metanotum are reddish brown, tinged with black. The propleuron, lower $\frac{2}{3}$ of pteropleuron, portion of mesopleuron surrounding spiracle and the hypopleuron are yellow. In some of the paratypes the area on each of mesonotum anterior to and in line with the dorsocentral bristles is brownish red giving the appearance, in strong direct light, of 2 vittae extending from anterior margin as far as anterior dorsocentral bristles. The front legs are very similar in the 2, the most striking difference is the comparatively sparse fascicula of the front basitarsus of *nigricolor*; consisting of only 5 long black hairs (fig. 13) rather than about 12 hairs (fig. 12). Also in *nigricolor* the hairs of the anteroventral row on front tibia are consistently longer toward the apical portion of the segment than in *villosa*. Otherwise fitting description of *villosa*. The wing is as in fig. 22.

Length: Body and wings 5.8–6.0 mm.

Female unknown.

Holotype male from Waikolu Stream, Hanalilolilo, Molokai, 3,800 ft., May 7, 1976 (K. Y. Kaneshiro). Three male paratypes same data (K. Y. Kaneshiro and H. T. Spieth). Type and one paratype in B. P. Bishop Museum, other paratypes in collection of the University of Hawaii.

THE APICALIS COMPLEX OF SPECIES

Comprised of *apicalis*, from Maui, and *stigma*, from Molokai.

Fits the villosa group of species and characterized by having the costal margin only slightly convex beyond middle; wing hyaline with a prominent apical brown spot (fig. 23–24); also the second tarsomere is slightly longer than wide (fig. 16). The characteristics of the male legs seem to be the same in the two species. The chromosomes have not yet been studied and the mating behavior has not been completely worked out.

The dorsal vestiture of the arista is very dense in *apicalis* with the hairs arranged in two or more rows at base. While in *stigma* the dorsal hairs are slightly spaced, arranged in two irregular or partial rows at base (fig. 4). This may be an indication that the latter is the more primitive of the two.

Drosophila apicalis Hardy, new species fig. 23

Near *stigma*, from Molokai, and differentiated by having the thorax yellow with a broad, brown, median vitta extending the full length of the mesonotum and over disc of scutellum, also with a narrower brown vitta on each side behind humerus, extending nearly to postalar bristles, interrupted at suture. The apical brown mark of the wing is smaller than in *stigma*, confined to apex of cell R_5 and upper $\frac{1}{2}$ of R_5 (fig. 23). The dorsal hairs on the arista are in pairs (2 rows) on the basal portion.

Male. Head: Shape and chaetotaxy as in other *Antopocerus*. Front and upper occiput brown pollinose, otherwise yellow. Antennae mostly dark brown, yellow on undersides of 1st 2 segments. Arista more nearly like fig. 5, with dorsal hairs densely placed on basal portion. *Thorax:* Yellow except for 3 brown vittae down mesonotum. *Wings:* Hyaline with brown spot in apex as in fig. 23; costal margin slightly convex beyond middle. *Legs:* Yellow. Front tibia slightly curved on anterior surface, with 8 to 9 long, curved, black ventral hairs on basal $\frac{1}{2}$ and row of short, nearly straight, recumbent dorsal hairs extending full length of segment; a few small setae are present on anterior surface just before apex. Basitarsus slender, slightly curved on anterodorsal surface and about $\frac{2}{3}$ as long as tibia. The basal $\frac{2}{3}$ of basitarsus devoid of long hairs; a strong anterior hair present on apical $\frac{2}{3}$ to $\frac{3}{4}$, this extends as far as apex of 2nd tarsomere. Also numerous erect, slightly curled, anterior and dorsal hairs present before apex of basitarsus and 2nd tarsomere. Second tarsomere slightly longer than wide, 3rd and 4th normal and other details of front legs as in fig. 16. *Abdomen:* Mostly dark brown, yellow over 1st tergum and posterolateral portions of terga 2 to 5. Genitalia yellow.

Length: Body and wings, 5.0–5.25 mm.

Female similar to male except for secondary sexual characters, also the apical wing spot is faint, not clearly developed.

Holotype male and allotype female, Auwahi, Maui, 3,400 ft., July 11, 1974 (K. Y. Kaneshiro). Sixteen male paratypes, all from same locality as type, collected from November to August 1965, 1969 and 1974 (K. Y. Kaneshiro, J. K. Fujii, J. P. Murphy and H. L. Carson). Type, allotype and some paratypes in B. P. Bishop Museum. Other paratypes in collections of the U. S. National Museum, British Museum (Natural History) and the University of Hawaii.

Drosophila (Antopocerus) stigma Hardy, new species
fig. 4, 16, 24

This is closely related to *apicalis*, from Maui, and the 2 are readily separated from other *Antopocerus* by having the wings hyaline with a conspicuous brown spot at apex (fig. 24). It is differentiated from *apicalis* by having the thorax dark brown, tinged with rufous in ground color, lacking vittae on mesonotum. The apical wing spot comparatively large, filling apices of cells R_1 , R_3 , and R_5 (fig. 24) and sometimes extending into upper apex of cell 2nd M_2 . Also the dorsal vestiture of the arista is arranged in 2 irregular rows of long curved hairs (fig. 4); in some specimens only a single row is apparent, 1 or 2 of the basal hairs may be paired and the validity of this character is not understood.

Otherwise fitting description of *apicalis*, the front legs of the male are as in fig. 16.

Length: Body and wings 5.0–5.25 mm.

Female. Fitting description of male except for secondary sexual characters.

Holotype male, Hanalilolilo, Molokai, 3,500 ft., Jan. 9–11, 1975 (A. Ohta). Allotype female, Puu Kolekole, Molokai, 3,600 ft., July 20, 1964 (H. L. Carson). 19 male paratypes from the following

localities on Molokai: Same as type (some collected by W. Ibara); same as allotype, June 1964–July 1965 (D. E. Hardy and H. L. Throckmorton); Hanalilolilo Trail, 3,500 ft., November 12, 1967 (H. L. Carson); S. of Hanalilolilo, July 1964 and 1975–March 1966 (W. B. Heed, H. T. Spieth and H. L. Carson); and Kaunuohua, July, 1969 (H. L. Carson). Type and some paratypes in the B. P. Bishop Museum. Remainder of paratypes in the collections of the U. S. National Museum, British Museum (Natural History) and the University of Hawaii.

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**A SYNOPSIS OF THE GENUS *PARASIMULIUM* MALLOCH (DIPTERA:
SIMULIIDAE), WITH DESCRIPTIONS OF ONE NEW SUBGENUS AND
TWO NEW SPECIES**

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ABSTRACT—A brief review of the genus *Parasimulium* is given which includes a key to the two subfamilies of North American Simuliidae, and a key and illustrations for the identification of the two subgenera and four species of this genus. One new subgenus, *Astoneomyia*, and two new species, *P. (P.) stonei*, and *P. (P.) crosskeyi*, are described. The genus is unique in that only males are known.

The genus *Parasimulium* Malloch, by virtue of its rarity and uniqueness, has stimulated the interest and curiosity of many dipterists since the time of its description. It is hoped this brief review will rekindle that interest and enhance the efforts to collect additional specimens of this fascinating and elusive group. Especially needed are the female and immature stages to help round out our knowledge concerning the true relationships of this genus to other members of the family. It is a great pleasure to dedicate this review of the genus *Parasimulium* to the honor and continued memory of an eminent dipterist and friend, Dr. Alan Stone.

Agreement among workers on the higher classification of the family Simuliidae has not yet been achieved. However, it is generally agreed among more recent workers (Smart, 1945; Crosskey, 1969; Rubtzov, 1974) that the genus *Parasimulium* shows such striking differences from other black flies that it is treated as the basis of a separate subfamily, the Parasimuliinae. On the other hand, Stone (1962, 1963a, 1964, 1965) treated this genus as the basis of the tribe Parasimuliini in the subfamily Prosimuliinae. Based upon a recent examination of seven of the eight known specimens of *Parasimulium*, the present author concurs with the former authors in recognizing the subfamily Parasimuliinae.

Subfamily Parasimuliinae

Parasimuliinae Smart, 1945, Trans. R. Entomol. Soc. Lond. 95:479.

This distinctive subfamily can be characterized and easily separated from the Simuliinae Newman, by the following key to the subfamilies of North American Simuliidae:

1. R_1 joining C slightly beyond middle of wing; branches of Rs conspicuously separated by membrane, posterior branch ending well before terminus of

C; C, Sc and radial veins with moderately long setae on dorsal and ventral surfaces; submedian m-cu fold simple apically; CuA₂ only moderately sinuous; basal cell absent (fig. 1, 2). Facets of eye all similar in size except for a few larger facets near middle of anterior margin of eye; eyes broadly separated by frons dorsally, touching or nearly so below antennae (fig. 15). Calcipala and pedisulcus absent. Mesepimeral tuft absent. Gonostylus without an apical spinule but internal apical margin may be sclerotized. Male only, female unknown. Parasimuliinae

- 1'. R₁ joining C well beyond middle of wing; if Rs forked then branches lying closer together, posterior branch ending near terminus of C; C, Sc, and radial veins with short setae that may or may not be present on 1 surface only; submedian m-cu fold distinctly forked apically; CuA₂ strongly sinuous; basal cell present or absent. Facets of dorsal ½ of male eye usually conspicuously larger than those of ventral ½; eyes usually touching or nearly so at middle of head above antennae, frons usually small. Calcipala and pedisulcus present or absent. Mesepimeral tuft present. Gonostylus of male usually with 1 or more apical spinules

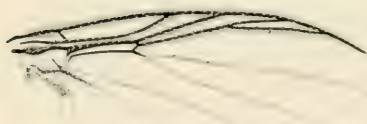
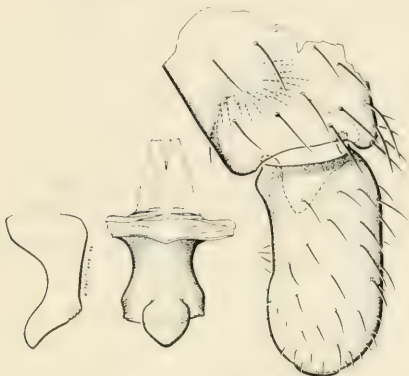
..... Simuliinae

The subfamily Parasimuliinae contains only the genus *Parasimulium*.

Genus *Parasimulium* Malloch

Type-species: *Parasimulium furcatum* Malloch (by monotypy).

Parasimulium Malloch, 1914, U.S. Dep. Agric., Bur. Entomol. Tech. Ser. 26:24. Knab, 1914, Ins. Insc. Mens. 2:180. Enderlein, 1921, Deut. Tierärztl. Woch. 29:199. Enderlein, 1921, Zool. Anz. 53:43. Dyar and Shannon, 1927, Proc. U.S. Nat. Mus. 69(10):2. Stiles and Hassall, 1928, Treasury Dep., U.S. Publ. Hlth. Serv., Hyg. Lab. Bull. 150:368. Enderlein, 1928, Zeitschr. Desinfekt. Gesundht. 20:10. Enderlein, 1930, Arch. Klassif. Phylog. Entomol. 1:87. Edwards, 1931, Dipt. Pat. S. Chile 2, Fasc. 4:122. Bequaert, 1934, In Strong, Sandground, Bequaert and Ochoa, Onchocerciasis. Harvard Univ. Press, Cambridge, p. 207. Twinn, 1936, Can. Jour. Res., D, 14:101. Rubtzov, 1940, Zool. Inst. Acad. Sci. USSR (N.S. 23) 6(6):251, 469. Stone, 1941, Proc. Entomol. Soc. Wash. 43:146. Vargas, 1941a, Rev. Inst. Salub. Enferm. Trop. 2:116. Vargas, 1941b, Rev. Inst. Salub. Enferm. Trop. 2:216. Stains and Knowlton, 1943, Ann. Entomol. Soc. Amer. 36:260. Vargas, 1945, Inst. Salub. Enferm. Trop. Monogr. 1:98. Smart, 1945, Trans. R. Entomol. Soc. Lond., 95:479. Vargas, Martínez Palacios, and Díaz Nájera, 1946, Rev. Inst. Salub. Enferm. Trop. 7:102. Vargas and Díaz Nájera, 1948, Rev. Inst. Salub. Enferm. Trop. 9:66. Nicholson and Mickel, 1950, Univ. Minn. Agric. Exp. Sta. Tech. Bull. 192:14. Wirth and Stone, 1956, In R. L. Usinger (Ed.), Aquatic insects of California. Univ. Calif. Press, Berkeley and Los Angeles, p. 403. Rubtzov, 1956, Zool. Inst. Acad. Sci. USSR (N.S. 64) 6(6):142. Shewell, 1958, Proc. Tenth Int. Cong. Entomol., Montreal. 1:643. Grenier and Rageau, 1960, Bull. Soc. Path. Exot. 53:738. Peterson, 1960, Great Basin Naturalist. 20:82. Rubtzov, 1960, Fliegen Palaerkt. Reg. 3 (14). Lfg. 206:98. Grenier and Rageau, 1961, Verhandl. XI. Int. Kong. Entomol., Wien. 1:175. Stone, 1962, Proc. Entomol. Soc. Wash. 64:174. Stone, 1963a, U.S. Dep. Agric. Tech. Bull. 1284:14. Dumbleton, 1963, New Zealand Jour. Sci. 6:321. Stone, 1963b, Bull. Brooklyn Entomol. Soc. 58:127. Stone, 1964, State Geol.

1 *Parasimulium melanderi* ♂2 *Parasimulium stoneri* ♂

3

4

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Parasimulium melanderi6 *Parasimulium furcatum*7 *Parasimulium furcatum*8 *Parasimulium furcatum*

Plate 1

Fig. 1-2, wings. 1, *Parasimulium* (A.) *melanderi*, holotype. 2, *P. (P.) stoneri*, holotype. Fig. 3-5, male terminalia of *P. melanderi*, holotype. 3, ventral plate, lateral view. 4, ventral plate, ventral view. 5, gonostylus and part of gonocoxite, ventral view. Fig. 6-8, male terminalia of *P. furcatum*, holotype. 6, terminal (end) view showing gonocoxite, gonostylus, ventral plate, median sclerite, and parameres. 7, same structures, ventral view. 8, same structures, lateral view. Terminal view (6) and lateral view (8) at right angles to plane of ventral view (7).

Nat. Hist. Surv. Conn. Bull. 97:10. Abdelnur, 1968, Quaest. Entomologicae. 4:121. Crosskey, 1969, Bull. Brit. Mus. (Nat. Hist.), Entomol. Suppl. 14:13. Rubtsov, 1974, Trudy Zool. Inst., Acad. Sci. USSR. 53:253 (p. 40 in English translation by British Library Lending Division).

Although the synonymy listed above is not complete, it does contain the main references to the genus *Parasimulium*.

The important characteristics of this genus are the same as those given above for the subfamily Parasimuliinae.

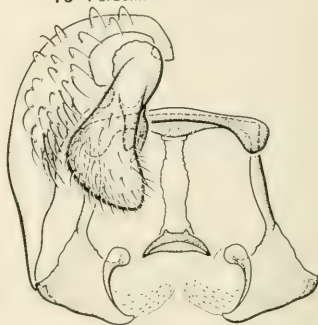
The historical aspects of the genus are largely presented by Stone (1941, 1962, 1963b) and need not be repeated here. A recent study of seven of the eight¹ known specimens of this genus has resulted in the recognition of two subgenera and four species which can be separated by the following key.

Key to the Subgenera and Species of *Parasimulium*
Males²

1. Stem of Rs shorter than or, at most, subequal to posterior branch (R_{4+5}) of fork; submedian m-cu fold faint, becoming evanescent at about level of distal end of anterior branch (R_{2+3}) of Rs; A_2 absent or very faint (fig. 2). Halter entirely yellow. Gonostylus yellow; in ventral view narrowing distally and somewhat rounded, pointed, or inner distal corner produced as a short, rounded, upturned lobe. Ventral plate of aedeagus, in ventral view, broad, dorsoventrally flattened, and somewhat H-shaped (fig. 7, 9, 13) *Parasimulium* (*Parasimulium*) *Malloch*.... 2
- 1'. Stem of Rs distinctly longer than posterior branch (R_{4+5}) of fork; submedian m-cu fold weak but extending more nearly to wing margin; A_2 present and distinct (fig. 1). Halter entirely brownish black. Gonostylus black; in ventral view broad, apex broadly rounded with a short, median sclerotization (fig. 5). Ventral plate of aedeagus, in ventral view, a narrow, subquadrate structure, with short, bulbous, apical liplike projection, and basal arms extending laterally at right angles beyond its margins (fig. 4) *Parasimulium* (*Astoneomyia*) *melanderi* Stone
2. Gonostylus relatively long, slender, and sinuous, its width more nearly uniform along its length. Ventral plate, in ventral view, narrower than in following species, its mediodistal margin more deeply concave, and with a series of distinct wrinkles or ridges (fig. 9) *stonei* n. sp.
- 2'. Gonostylus relatively short, its base obliquely narrow, abruptly enlarging at about $\frac{1}{2}$ to $\frac{2}{3}$ its length then tapering distally to a broader, obliquely rounded, or narrow, upturned point. Ventral plate, in ventral view, broad, its mediodistal margin nearly straight across, or shallowly concave, and without distinct wrinkles or ridges (fig. 7, 13) 3
3. Inner distal corner of gonostylus produced as a short, rounded, upturned lobe. Mediodistal margin of ventral plate nearly straight across; apico-

¹ The single specimen in the British Museum (Natural History) was available for study only after this paper was sent to press.

² The female and immature stages are not known.

9 *Parasimulium stonei*10 *Parasimulium stonei*11 *Parasimulium stonei*12 *Parasimulium crosskeyi*13 *Parasimulium crosskeyi*14 *Parasimulium crosskeyi*

- lateral processes more slender distally, enlarged shoulderlike at about level of mediodistal margin (fig. 7) *furcatum* Malloch
- 3'. Inner distal corner of gonostylus more obliquely and evenly rounded, without a distinct upturned lobe. Mediodistal margin of ventral plate shallowly but distinctly concave; apicolateral processes more uniformly broad throughout (fig. 13) *crosskeyi* n. sp.

Subgenus *Parasimulium* Malloch

The characters of this subgenus are presented in the above key. Three closely related species, *P. furcatum* Malloch, *P. stonei* n. sp., and *P. crosskeyi* n. sp., are assigned to this taxon.

Parasimulium (*Parasimulium*) *furcatum* Malloch

fig. 6, 7, 8, 17

Parasimulium furcatum Malloch, 1914, U.S. Dep. Agric., Bur. Entomol. Tech. Ser. 26:24; fig. 4. Knab, 1914, Ins. Insc. Mens. 2:180. Dyar and Shannon, 1927, Proc. U.S. Nat. Mus. 69(10):3; pl. 1, fig. F. Stone, 1941, Proc. Entomol. Soc. Wash. 43:146; figs. 1-6. Stains and Knowlton, 1943, Ann. Entomol. Soc. Amer. 36:260. Vargas, 1945, Inst. Salub. Enferm. Trop., Monogr. 1:140. Smart, 1945, Trans. R. Entomol. Soc. Lond. 95:479. Stone, 1962, Proc. Entomol. Soc. Wash. 64:174 (part). Stone, 1963b, Bull. Brooklyn Entomol. Soc. 58:128 (part).

Holotype. ♂, Redwood Creek, Bair's Ranch, Humboldt County, Calif., H. S. Barber. Cat. No. 15405, USNM.

Remarks. This species was reasonably well described by Malloch (1914), briefly redescribed by Dyar and Shannon (1927), and some features were more extensively described by Stone (1941). After the discovery of two additional specimens of *Parasimulium* in the Melander collection, Stone (1962) amplified the description with notes on a few of the external characters not mentioned in the original description because of the poor condition of the type specimen. However, these amplifications were based on specimens which are now included as part of the type-series of the new species *P. stonei* described below, and possibly might not hold true for *P. furcatum*. Only by the discovery of additional specimens of *P. furcatum* can this be ascertained and an adequate description of the species be made. The features of *P. melanderi* Stone noted by Stone (1963b) to be com-

←

Plate 2

Fig. 9-14, male terminalia. 9-11, *Parasimulium stonei*, holotype. 9, ventral view showing gonocoxite, gonostylus, ventral plate, median sclerite, parameres, and aedeagal membrane. 10, same structures, lateral view. 11, same structures, terminal view. 12-14, *Parasimulium crosskeyi*, holotype. 12, same structures, terminal view. 13, same structures, ventral view. 14, same structures, lateral view.

monly shared with *P. furcatum*, were characters of generic value and apply equally well to all four species now included in the genus *Parasimulium*.

Parasimulium furcatum can be distinguished from *P. stonei* and *P. crosskeyi* by the features given in the key. If Malloch's description of *P. furcatum* is accurate in light of the condition of the specimen, and it can only be assumed that it is, the following features will also help to distinguish it from the two new species: Frons undusted (greyish pollinose in *stonei* and *crosskeyi*); second (*sic*) segment (= scape) of antenna black (yellow in *stonei* and *crosskeyi*); abdomen brown except basal scale (= tergum 1) yellow (terga 1 and 2, and sterna 1-3 yellow in both *stonei* and *crosskeyi*); and, knob of halter brown, its stem yellow (halter entirely yellow in *stonei* and *crosskeyi*).

It should be noted that Stone had mounted the remaining parts of the broken specimen of *P. furcatum* on a slide. These parts were generally unsuitable for study due to shifting under the cover slip. They have been removed from the slide and are now in glycerine to facilitate their study.

Parasimulium (*Parasimulium*) *stonei* Peterson, new species
fig. 2, 9, 10, 11, 15, 16, 18

Parasimulium furcatum, Stone, 1962, Proc. Entomol. Soc. Wash. 64:174 (part). Stone, 1963a, U.S. Dep. Agric. Tech. Bull. 1284:14 (part). Stone, 1963b, Bull. Brooklyn Entomol. Soc. 58:128 (part).

Description. Male. General color of thorax orange brown to dark brownish black; abdomen brownish black except basal segments which are yellow. Length: Body, 1.7-1.8 mm (based on 2 whole pinned specimens), wing, 1.7-2.2 mm (based on 1 slide mounted and 2 pinned specimens).

Head (fig. 15) dark reddish brown to brownish black, greyish pollinose; with sparse yellow pile and a few longer brownish setae; 0.4-0.5 mm wide, slightly narrower than thorax. Frons widening dorsally, about twice as wide at inner dorsal angles of eyes as at narrowest point above antennae; clypeus small with sparse brownish pile. Anteromedial facets of eye larger than others which somewhat decrease in size dorsally, ventrally, and posteriorly; small but distinct, slightly raised, shiny bulla present near dorsolateral margin of eye. Antenna with 8 flagellomeres; entirely pale yellow, with longer than usual pale pile; pedicel slightly longer and wider than scape, and about twice as long as basal flagellomere. Palpus yellowish brown, with pale yellow pile; segment 5 about as long as segments 3 and 4 combined; segment 3 enlarged, somewhat globular. Sensory vesicle of 3rd palpal segment about $\frac{1}{3}$ as long as segment, opening to exterior by a distinct, rather uniformly wide neck, its mouth rounded.

Scutum, scutellum, and postnotum concolorous, greyish pollinose; scutum with short, recumbent, yellow pile, and a few longer brownish setae laterally and posteromedially; scutellum with long brownish setae. Pleuron slightly paler than dorsum of thorax, with a rather uniform greyish pollinosity; mesepimeral tuft absent. Katapisternum short and narrow, weakly delineated from

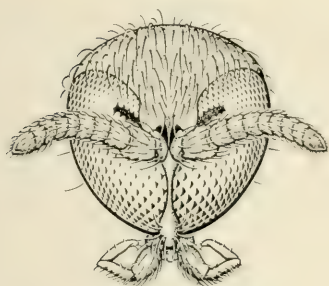
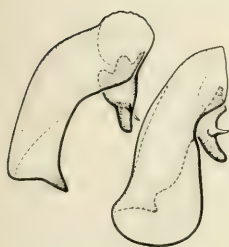
15 *Parasimulium stonei* ♂16 *Parasimulium stonei* ♂17 *Parasimulium furcatum*18 *Parasimulium stonei*19 *Parasimulium crosskeyi*

Plate 3

Fig. 15–19, 15–16, *Parasimulium stonei*, holotype. 15, head. 16, thorax, lateral view. 17–19, gonostyli of male terminalia in situ, showing left gonostyli in posteroventrolateral view (this view shows left gonostylus in its broadest aspect, and right gonostylus in its narrowest aspect). 17, *P. furcatum*. 18, *P. stonei*. 19, *P. crosskeyi*.

anepisternum by a wide, shallow depression. Wing as in fig. 2; membrane hyaline, faintly yellowish; veins pale yellow; setae on stem vein and base of costa pale yellow, rest of setae on veins varying from yellow to brownish. Halter pale yellow, with yellow pile. Legs entirely yellow to reddish yellow, with yellow pile and a few longer brownish setae; hind basitarsus not swollen, about 4.5 times as long as wide.

Abdominal terga 1 and 2 yellow; terga 3–9 reddish brown to brownish black, greyish pollinose, their hind margins narrowly yellowish grey; sterna 1–3 yellow, remaining sterna concolorous with posterior terga; basal fringe and most abdominal setae yellow, but a few brownish setae may be present especially on posterior segments. Terminalia as in fig. 9–11, 18. Gonocoxite brownish black, with sparse yellow pile; subconical in shape, greatest width nearly equal to greatest length; dorsal margin with a broad, slightly raised, subapical convexity bearing yellow setae; outer distal margin with a short, distinct, and rather broad digitiform process that articulates with base of gonostylus. Gonostylus yellow, with fine yellow setae; rather long and slender, tapering distally to a narrowly rounded or pointed apex, about 3 times as long as greatest width which is about

mid length and at which point there is a small sclerotization that articulates with apicolateral process of ventral plate. Associated with base of gonostylus is a small, heavily sclerotized two-pronged structure that overlaps inner margin of apicolateral process of ventral plate; 1 prong of this structure is long, slender and pale, while other prong is short, broad, and blunt. Ventral plate of aedeagus somewhat H-shaped, narrower than in other 2 species of same subgenus, its apicolateral arms moderately broad and heavily sclerotized, distal margin between these arms rather deeply concave and with a series of distinct wrinkles or folds that protrude pouchlike in lateral view; proximal margin between basal arms narrowly produced V-like to which median sclerite is attached. Median sclerite consisting of a long, slender basal section that curves posteriorly away from its point of attachment to ventral plate, and gradually expands distally for about $\frac{1}{2}$ its length, then rather abruptly expands clublike and whose apical margin is faintly notched medially. Paramere a large, heavily sclerotized, subrectangular, trough-like structure, with a broad but unevenly rounded apex; attached basally to apex of basal arm of ventral plate by a long, slender arm or process, and by a very short, slender bar to dorsolateral corner of gonocoxite. Aedeagal membrane with 2 patches of minute spiniform processes.

Female and immature stages unknown.

Holotype. ♂, Bolling Park, California, June 19, 1935, A. L. Melander. According to Stone (1963b), "This locality is not certain but is probably Bolling Grove in the Humboldt Redwoods area, Humboldt County."

Paratypes. 2♂♂, Viento [Hood River County], Oregon, July 1, 1917, A. L. Melander (USNM, CNC).

Remarks. This species is closely related to both *P. furcatum* and *P. crosskeyi* n. sp. However, it can easily be distinguished from them by its long slender gonostyli, and the more narrow ventral plate with its conspicuous wrinkles or folds that, in lateral view, appear to form a pouchlike bulge. Other possible characters for separating *P. stonei* and *P. furcatum* are discussed under the latter species.

Parasimulium (*Parasimulium*) *crosskeyi* Peterson, new species
fig. 12, 13, 14, 19

Parasimulium furcatum, Stone, 1963b, Bull. Brooklyn Entomol. Soc. 58:128 (part).

Description. Male. As far as can be determined from the 2 specimens at hand, this species agrees in all particulars with *P. stonei* except for the structural details of the terminalia. Terminalia as in fig. 12-14, 19; larger in overall size than in other 2 species of this group. Gonocoxite subconical, greatest length slightly more than greatest width; digitiform process on outer distal margin rather long, slender, and slightly enlarged apically. Gonostylus yellow, with yellow pile; rather slender on basal $\frac{2}{3}$, then somewhat abruptly widening, then tapering mesally to an obliquely rounded or pointed apex, base obliquely narrow; greatest length about 2.75 times its greatest width; point of greatest width on outer margin with a small sclerotization that articulates with apicolateral process of ventral plate. Associated with base of gonostylus is a small, heavily

sclerotized two-pronged structure which is similar to that in *P. stonei* but is somewhat larger. Ventral plate of aedeagus similar to that of *P. stonei*, somewhat H-shaped but much broader and with larger apicolateral processes, less deeply concave distal margin, and without wrinkles or folds. Median sclerite similar to that of *P. stonei* but enlarged apical section with a shallow notch that appears to extend to near its base as a weakened line. Paramere a large, heavily sclerotized, troughlike plate similar to that of *P. stonei* but its apical margin more evenly rounded, and entire structure shaped as in fig. 14. Aedeagal membrane with two patches of minute setae-like processes.

Female and immature stages unknown.

Holotype. ♂, Benson Park [Multnomah County], Oregon, June 24, 1935, A. L. Melander.

Paratypes. 1♂, Corvallis [Benton County], Oregon, June 21, 1925, A. L. Melander. 1♂, Eagle Creek [Hood River County], Oregon, June 15, 1925, A. L. Melander [BM[NH]].

Remarks. This species is very similar to *P. stonei* on the basis of external characters, but is more similar to *P. furcatum* in the structure of its terminalia. *Parasimulium crosskeyi* seems to be intermediate between these two species. However, it is easily distinguished by the structural details of the terminalia as outlined in the key and by comparing the accompanying illustrations.

This species is named in honor of another eminent dipterist and friend, Dr. R. W. Crosskey of the British Museum (Natural History).

Astoneomyia Peterson, new subgenus

Type-species: *Parasimulium melanderi* Stone

This subgenus is characterized and can be separated from the nominate subgenus by the features given in the key. In addition, the only included species, *P. melanderi*, is totally brownish black with brownish-black pile, and has very different terminalia as can be seen from the accompanying illustrations. The future discovery of additional stages of the unique type-species may require this subgenus to be elevated to full generic status.

Parasimulium (*Astoneomyia*) *melanderi* Stone

fig. 1, 3, 4, 5

Parasimulium melanderi Stone, 1963b, Bull. Brooklyn Entomol. Soc. 58:127; figs. 1-4.

Holotype. ♂, Nooksack River, Mt. Baker, Washington, August 11, 1925, A. L. Melander.

Remarks. This species was well described and illustrated by Stone (1963b) and need not be redescribed here although improved illustrations of the species are provided. *Parasimulium melanderi* is

readily separated from the other three species of the genus. In fact, the features of the wing, the color of the body integument and pile, and especially the unusual structure of the terminalia, all as detailed in the key, make it sufficiently distinctive to merit its placement in a separate subgenus as is done here.

Stone mounted the left wing and the terminalia of *P. melanderi* on a slide, but because they had shifted position and parts of the terminalia were not under the coverslip, all these parts were removed from the slide and are now stored in glycerine.

I am grateful to Dr. F. C. Thompson, Systematic Entomology Laboratory, United States Department of Agriculture, Washington, D.C., for the loan of specimens used in this study. I express my appreciation to Dr. Lloyd Knutson, editor of this journal, for inviting me to contribute to this special issue honoring Dr. Alan Stone.

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CHRYSOPS STONEI, A NEW TABANID FROM JAPAN
(DIPTERA: TABANIDAE)

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ABSTRACT—*Chrysops stonei* is described from Hokkaido, Japan. It is related to *C. mlokosiewiczzi* and *C. vanderwulpi*. The status of *C. vanderwulpi* is discussed.

It is a pleasure to dedicate a new tabanid to Dr. Alan Stone who has done so much to advance our knowledge of this family.

Chrysops stonei Pechuman, new species

Holotype (♀): Length: 10 mm.

Head: Frons essentially parallel sided. First antennal segment yellow, 2nd and basal portion of 3rd yellow brown, annuli dark brown, nearly black; first 2 segments with black hairs. Frontal callus dark brown, nearly black, large, oval, narrowly separated from eyes. Facial and frontal pollen yellow except around and between ocelli where it is dark brown; pollinose triangular area on frontoclypeus extends from beneath antennae nearly to level of frontoclypeal pits; balance of frontoclypeus shining dark yellow, somewhat darker in area of frontoclypeal pits. Cheeks with very small shining black spot below. First segment of palpi brownish, 2nd dark yellow with short black hair and much longer yellow hairs. Proboscis black.

Thorax: Dorsum yellow pollinose and yellow haired with 3 dark brown stripes which run entire length, center stripe $\frac{1}{2}$ as wide as sublateral stripes; scutellum entirely yellow pollinose and yellow haired. Pleurae yellow pollinose and yellow haired with dark integument visible in thinly pollinose areas. Stem of halteres yellow, knob brown. Fore coxae, middle and hind femora yellow and yellow haired; middle and hind coxae fuscous; fore femora yellow with apical $\frac{1}{4}$ dark brown, mostly dark haired; fore tibiae yellow at base with apical $\frac{3}{4}$ dark brown, mostly dark haired; middle and hind tibiae dark yellow, mostly dark haired; all tarsi dark brown except metatarsi of middle and hind legs which are yellow brown. Wing as figured; dark pattern pale and crossband much reduced when compared with most related species; center of discal cell, both basal cells, 2nd submarginal, 4th and 5th posterior and anal cells with little evidence of infuscation.

Abdomen: First tergum completely yellow; 2nd through 5th terga yellow with 4 narrow black markings on each segment which give a quadristriate appearance to abdomen; black markings on the 2nd tergum do not reach either margin and sublateral spots are less distinct than submedian spots; markings of 3rd through 4th terga reach anterior margin but do not quite reach posterior margin; markings of 5th tergum all reach both margins of segment; 6th tergum black, yellowish laterally. Venter, through 4th sternum, yellow with small dark spot

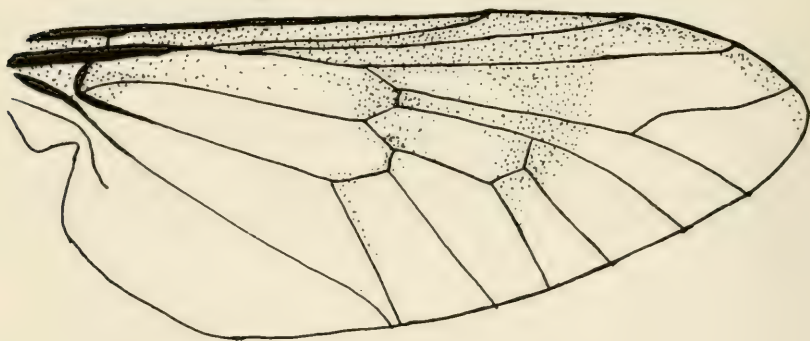


Fig. 1, wing of *Chrysops stonei*.

near center of 2nd sternum; 5th sternum yellow with darker shading near posterior border; remaining sterna dark brown with some yellowish shadings.

Holotype: Shirikishinai, Kamedagun, Hokkaido, Japan, 20 August 1964 (M. Munakata).

Paratypes: 4 ♀♀, same data as holotype; 2 ♀♀, same locality as holotype, 25 August 1971, 20 August 1973 (A. Taguchi); 1 ♀ Ikusagawa, Ohnuma-Park, Hokkaido, 27 July 1961 (M. Munakata). One ♀ with badly damaged abdomen is not included in the paratype series but head and wing characters match the type of *stonei*. It is labeled Mimasaka, Japan, July 1912 (J. C. Thompson). If this locality refers to the former province of Mimasaka on Honshu, it is a considerable extension of range.

The holotype is temporarily retained in my collection. Paratypes are being placed in the Cornell University Insect Collection and are being sent to Dr. Meiyō Munakata, Hokkaido University of Education, Hakodate and to Dr. N. G. Olsufjev, Moscow.

Variations. The series varies in length from 8 to 11 mm, with a median length of 9.6 mm. Leg color and wing pattern show almost no variation. The abdominal pattern is quite consistent but in some specimens the submedian black spots reach the posterior margin of the 2nd tergum and in one specimen the sublateral markings are reduced on terga 3 through 5 and are absent on the 2nd tergum. Three paratypes show traces of dark spots on the 1st tergum but none have the dark spot under the scutellum found in *vanderwulpi*. One specimen lacks the black spot on the 2nd sternum. The ratio of length of scape to flagellum varies from 1 to 2.24 to 1 to 2.58.

The discovery of a new *Chrysops* in an area as heavily collected as Hokkaido is surprising and I was at first inclined to regard these specimens as a local variant of *C. vanderwulpi* Kröber. However, specimens of *vanderwulpi* from Hokkaido and from mainland Asia

supplied by Dr. Munakata and Dr. Olsufjev respectively showed a number of consistent differences. In *vanderwulpi* the frons is somewhat widened below, the frontal callus is yellow to brown or less commonly black with a brown center, the pollinosity between and around the ocelli is yellow like the rest of the frons, not brown as in *stonei*, the fore tibiae are entirely yellow or darkened only near the apex, even abnormally pale *vanderwulpi* show dark spots on the 1st abdominal tergum which generally meet beneath the scutellum whereas in *stonei* this tergum has only two small dots or is completely yellow and most *vanderwulpi* have distinct dark spots on the 2nd through 4th abdominal sterna. In most *vanderwulpi* the median frontoclypeal pollen is in the form of a stripe, parallel sided below its origin and acutely pointed below, usually extending below the level of the frontoclypeal pits, whereas in *stonei* the pollen is in the form of an equilateral triangle barely or not reaching the level of the pits. The most obvious differentiating character from *vanderwulpi* is the reduced and paler wing pattern with almost no indication of the projection from the crossband in the first submarginal cell characteristic of *vanderwulpi*.

The wing pattern of *stonei* has a superficial resemblance to *Chrysops oxianus* Pleske, 1910, but this is a grayish species with a very small frontal callus and extensive pollinose frontoclypeal stripe. From *Chrysops mlokosiewiczzi* Bigot, a species not known from Japan, it is separated by the reduced wing markings, different pattern of markings on the 2nd abdominal tergum, lack of spot under the scutellum and the scape shorter in proportion to the flagellum; the type series of *stonei* has an average ratio of scape to flagellum of 1 to 2.45 and in a series of *mlokosiewiczzi* from various localities the average ratio is 1 to 1.87.

Some comment on the status of *Chrysops vanderwulpi* is, perhaps, appropriate at this time. Kröber (1929) proposed *vanderwulpi* as a new name for *Chrysops striatus* van der Wulp, 1885, which is pre-occupied by *Chrysops striatus* Osten Sacken, 1875. He treated it as a variety of *mlokosiewiczzi* Bigot, 1880. Most subsequent workers have treated *vanderwulpi* as a full species and I agree with this status. Some workers have placed *striatus* van der Wulp as a synonym of *mlokosiewiczzi*, which if true, would also place *vanderwulpi* Kröber as a synonym. Stone (*in* Delfinado and Hardy, 1975) follows this line of reasoning which in effect leaves the species presently called *vanderwulpi* without a name.

Through the kindness of Dr. A. Diakonoff and Dr. P. J. van Helsing of the Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands, I have been able to study the holotype of *Chrysops striatus* van der Wulp from Amoy, China. The type is in good condition. It is not *mlokosiewiczzi* but the species currently known as *vanderwulpi*

Kröber. It is separated at once from *mlokosiewiczzi* by the projection from the crossband in the first submarginal cell and the relative proportions of the scape, pedicel and flagellum which have a ratio of 1: 0.83: 2.3. Therefore, Kröber's replacement name *Chrysops vanderwulpi* for *C. striatus* van der Wulp is valid and both names should be removed from synonymy under *C. mlokosiewiczzi*.

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**BIOLOGY OF ANTICHAETA MELANOSOMA (DIPTERA:
SCIOMYZIDAE), WITH NOTES ON PARASITOID
BRACONIDAE AND ICHNEUMONIDAE (HYMENOPTERA)**

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ABSTRACT—Flies of the genus *Antichaeta* are among the few insects known to kill and feed solely on the eggs of snails during at least part of their life cycle. Females of the North American *A. melanosoma* lay their eggs only onto egg masses of an aquatic snail, *Aplexa hypnorum*, found in vernal ponds, swamps, and woodland pools. Young larvae feed only on snail embryos, but older larvae also prey on adult *A. hypnorum*. The life cycle of the fly is synchronized with seasonal changes in the water level of the ephemeral habitat and with the seasonal behavior of the food snail. At least 7 species of parasitoid Hymenoptera (Braconidae and Ichneumonidae) appear to have life cycles closely correlated with *A. melanosoma*, which provides them an availability of host larvae at the time of mating and oviposition. Adult flies and wasps emerge sequentially in the spring from overwintered puparia.

We are pleased to present this paper in honor of our good friend and colleague, Dr. Alan Stone, despite the fact that he has not had the good fortune to work on this superior group of flies.

The only insects known to feed exclusively, during at least part of their development, on the eggs of molluscs are larvae of *Antichaeta* Haliday (Diptera: Sciomyzidae) (Fisher and Orth, 1964; Knutson, 1966) and of *Megaselia aequalis* (Wood) (Diptera: Phoridae) (Robinson and Foote, 1968). The genus *Antichaeta* includes six palearctic and eight nearctic species, none of which is holarctic in distribution. An undescribed species is known from Michoacan, Mexico (K. Valley, pers. comm.). The adults are found on herbaceous vegetation around the margin of various aquatic and damp habitats and never appear to be particularly abundant.

The first species of Sciomyzidae reported to feed primarily on snail eggs was a western North American species, *A. testacea* Melander (Fisher and Orth, 1964). Subsequently, Knutson (1966) reported on the life histories of two European species, *A. analis* (Meigen) and *A. brevipennis* (Zetterstedt), whose larvae feed during part of the life cycle on snail eggs.

Antichaeta melanosoma Melander is the most common nearctic member of the genus. This paper presents for the first time informa-

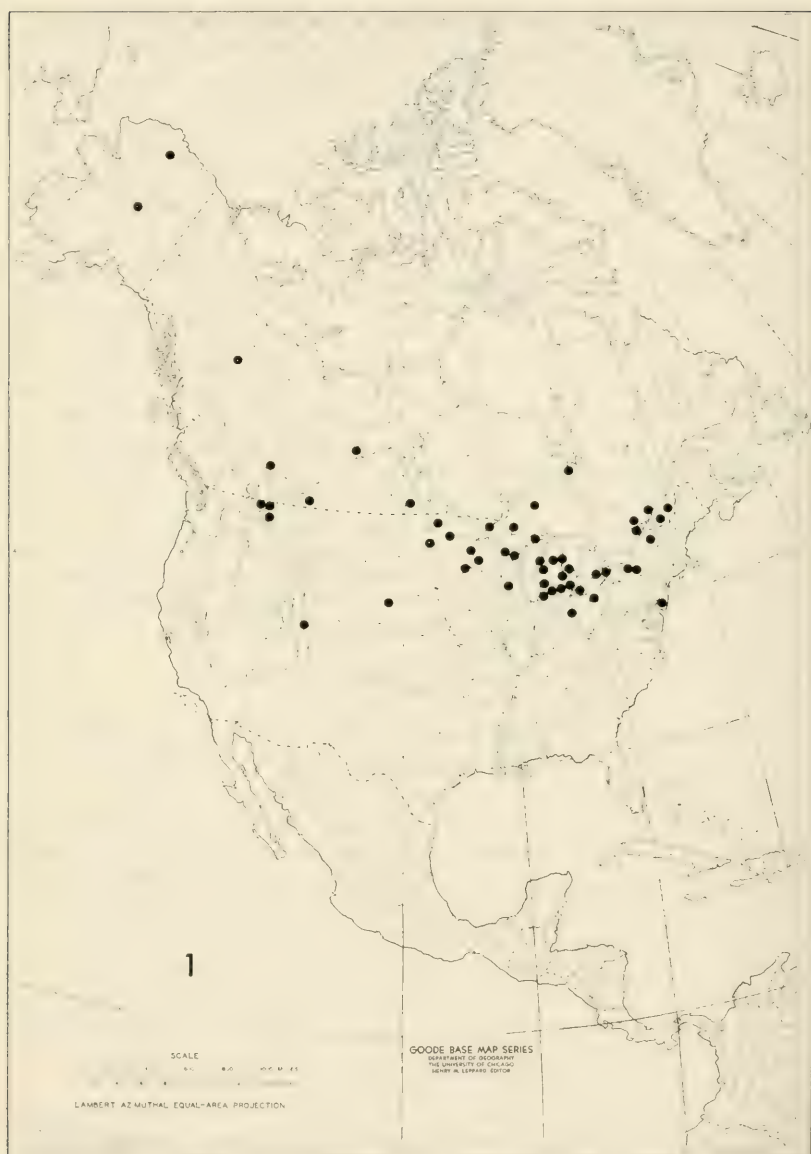


Fig. 1, Distribution of *Antichaeta melanosoma*.

tion on its life cycle, host preference, and natural enemies. The seasonal relationships of *A. melanosoma* to its principal snail host and its hymenopterous parasitoids living in the same vernal aquatic habitats are discussed.

BIOLOGY OF *ANTICHAETA MELANOSOMA*

From the known northern and western limits, ranging from Alaska (Umiat) to Utah (Vernal), *A. melanosoma* extends eastward to Quebec (Berthierville) and New Jersey (Burlington Co.) (fig. 1). The range of the fly is almost as extensive as that of its principal food snail, *Aplexa hypnorum* (L.), which is found throughout North America from east of the Cascade Mountains to the Atlantic Coast and from Alaska and Hudson Bay south to the vicinity of the Ohio River.

The breeding habitats seem to be limited to vernal ponds, swamps, and woodland pools. Such places are water-filled during spring, but they are almost or completely dry by early to midsummer. The life cycle of the fly is intimately associated with these changes in water level and with the seasonal behavior of *Aplexa hypnorum*, which also occurs abundantly in such vernal situations. *Antichaeta melanosoma*, in fact, exhibits more such temporally correlated life cycle characteristics than any of the approximately 200 species of Sciomyzidae that have been reared to date, except certain species of *Renocera* (Foote, 1975).

The general aspect of the habitat apparently has little influence on the fitness of the site as a breeding place for *A. melanosoma*; the seasonal change in water level is the critical factor. This was demonstrated dramatically at the two sites near Brooktondale, New York, where most of the field work was carried out. One locality (junction of Van Demark and Landon Roads) is a vernal pond (10 × 10 m) partially shaded by *Ulmus americana* L., *U. rubra* Muhl., *Pyrus malus* L., and *Pinus strobus* L. The other locality (Lounsbery Road), which is 1 km to the east, is an extensive dense, heavily shaded, mixed woods (consisting chiefly of *Acer saccharum* Marsh., *Carya ovata* (Mill.), *Quercus* sp., and *Tsuga canadensis* L.) in which there are many very small (3 × 3 m) vernal pools. On April 13, 1966, most of the vernal pond was filled to a depth of 0.5 m, and the vernal pools contained 0.2 to 0.3 m of water. The vernal pond supports a dense growth of *Carex* and *Juncus* and is bordered by *Onoclea*, *Solidago*, *Aster*, *Frageria*, and other herbaceous vegetation. The small vernal pools have a thick mat of dead and decaying leaves over the mud bottom and are surrounded by luxuriant growths of vegetation, mainly *Iris pseudacorus* L. *Aplexa hypnorum* was by far the most abundant aquatic gastropod at both localities. Aquatic molluscs were represented by a few *Lymnaea palustris* (Müller) and many finger-nail clams (Sphaeriidae) in the vernal pools at Lounsbery Road, but these were not found in the vernal pond. A few terrestrial snails (*Oxyloma* sp., *Cionella lubrica* (Müller), *Discus patulus* (Deshayes), and the slug *Deroceras reticulatus* (Müller) were found on the slightly

higher ground between the pools in the wet woods on Lounsbery Road. *Derocerus reticulatus* also was present at the vernal pond. The water levels at the two sites changed at about the same rate, although the dead leaves in the bottom of the shaded pools remained damp longer than did the relatively bare floor of the vernal pond. In 1965, standing water had disappeared from both places by May 22. Other Sciomyzidae present at the vernal pond were: *Atrichomelina pubera* (Loew), *Pherbellia nana* (Fallén), *Tetanocera loewi* Steyskal, and *T. plebeia* Loew (all common) and *Dictya pictipes* (Loew) (rare). *Atrichomelina pubera* and *P. nana* were common around the vernal pools, but *Pteromicra pectorosa* (Hendel), *P. sphenura* Steyskal, *Renocera longipes* (Loew), *Tetanocera clara* Loew, *T. loewi*, *T. oxia* Steyskal, and *T. plebeia* were rather rare. The aquatic predators *Sepedon armipes* Loew, *S. fuscipennis* Loew, and *Elgiva sundewalli* Kloet and Hincks were abundant at the margin of an exposed farm pond only 30 m from the vernal pools, but these species never were found at the pools.

Other localities in New York where *A. melanosoma* were collected include: Montezuma Marsh at the town of Seneca Lake; a grove of *Alnus* and *Populus* in a marsh at the junction of New York Route 13 and Floral Avenue, Ithaca; a vernal swamp southeast of Albion; and a vernal swamp and pond at the junction of U. S. Route 20 and Savage Road, about 5 km west of Geneva. A specimen in the University of Minnesota Collection was taken in a "tamarack swamp" in Hennepin Co., Minnesota.

In northwestern Montana, adult *A. canadensis* (Curran) and *A. melanosoma* occurred together in the same vernal pool in a coniferous forest. Eggs and larvae of both species were found in egg masses of *Aplexa hypnorum*. (B. A. Foote, pers. comm.).

Laboratory observations were based on rearings initiated with eggs, larvae of all three instars, pupae, and adults collected at the two localities near Brooktondale during 1965. Supplemental information in regard to habitat and emergence and mating of adults was provided by notes associated with pupae collected at several localities in central New York during 1957 and 1958 by B. A. Foote.

A short and simple epigamic routine was noticed when recently emerged males were placed with recently emerged females. The male took a position directly in front of the female, facing her, and with his head about 4.0 mm from her head. The male moved his front legs rapidly and jerkily apart and together again for a few seconds before mounting the female, with his head above her head. During mating, the male's front tarsi were placed on the parafrontal regions of the female's head, the apices of his middle tibiae rested on the basicostal margins of her half-outstretched wings, and his hind tarsi grasped her postabdomen.

Adults in breeding jars occasionally were seen feeding on the sides of egg masses of *Aplexa hypnorum*.

Adults (fig. 2) collected on June 6 mated in the laboratory the same day. In nature, mating may occur much earlier than observed in the laboratory; some adults mated within 24 hours after they emerged from puparia in the laboratory on March 28. In central New York, mating begins at least as early as May 22; a female collected on that date and kept without a male in the laboratory subsequently laid viable eggs.

Eggs were found in nature on June 5, but collections of young third-instar larvae on the same date show that oviposition in nature begins at least as early as May 29. Two females that emerged in the laboratory on April 20 and 21 laid their first eggs 4 to 16 days later, respectively. One of these females laid 181 eggs (May 7 to 27), and the other laid 319 (April 24 to May 27). (B. A. Foote, pers. comm., notes that most of the oviposition recorded in rearings in northwestern Montana occurred during July). Females readily oviposited onto egg masses of *Aplexa hypnorum*, *Physa* sp., and *Lymnaea palustris*, but they did not lay eggs on living or dead snails, on fresh vegetation, or on any other substrate available in the breeding jars. One to 27 eggs, usually about ten, were laid onto each egg mass in the laboratory. However, infested egg masses of *A. hypnorum* collected in nature bore only one to four eggs each. The fly eggs rested on the surface of the snail egg masses. Each egg of *A. melanosoma* was enclosed (except the anterior and posterior apices) by a thin coat of clear, colorless, gelatinous material which probably is secreted during the process of oviposition. The incubation period was 24 to 48 hours at 21 to 27 C.

Many eggs were laid on egg masses of *Lymnaea palustris* (Lymnaeidae) but most of these larvae died during the first stadium. Only a few larvae developed to the third stadium on *L. palustris*, and none formed puparia. Successful rearings from hatching to puparium formation were obtained mainly with egg masses of *Aplexa hypnorum* and to a lesser extent with egg masses of *Physa* sp. (both members of Physidae). Larvae that hatched on eggs of *L. palustris* either starved or migrated to egg masses of *A. hypnorum* or *Physa* sp. when the latter were added to the rearing containers. In nature, first-, second-, and third-instar larvae were found feeding only in egg masses of *A. hypnorum*. The food habits of North American species of *Antichaeta* are summarized in Table 1.

Each newly hatched larva immediately entered the snail egg mass upon which the egg had been laid. The larva did not lie freely in the gelatinous matrix while it was attempting to penetrate the egg, but crawled onto the surface of the spherical egg. The larva's posterior spiracles were completely without contact with the air unless the



Fig. 2, *Antichaeta melanosoma*, adult, female. Fig. 3, third instar larva of *Antichaeta melanosoma* attacking adult *Aplexa hypnorum*.

Table 1.—Food habits of North American species of *Antichaeta*

<i>Antichaeta</i> Species	Gastropod Eggs Utilized	Reference
<i>borealis</i> Foote	<i>Oxyloma</i> , <i>Catinella</i>	Robinson (1966)
<i>canadensis</i> (Curran)	<i>Aplexa</i>	Foote (rearing notes)
<i>fulva</i> Steyskal	<i>Lymnaea</i>	Foote (rearing notes)
<i>johnsoni</i> (Cresson)	unknown	—
<i>melanosoma</i> Melander	<i>Aplexa</i>	Knutson and Abercrombie (present paper)
<i>robiginosa</i> Melander	unknown	—
<i>testacea</i> Melander	<i>Oxyloma</i> , <i>Succinea</i>	Fisher and Orth (1964)
<i>vernalis</i> Fisher and Orth	unknown	—

egg being attacked was very near the wall of the egg capsule. During the 12 to 24 hours after hatching, rapid and rhythmic back and forth rasping movements of the mouthhooks and post-oral spin band succeeded in rupturing the tough chorion. However, first-instar larvae that penetrated into the gelatinous matrix of *Lymnaea palustris* egg masses did not seem to break through the chorions of those eggs. Development of a few larvae on eggs of *L. palustris* may have been due to accidental rupture of the eggs during transferral from aquaria to the breeding jars. First-instar larvae consumed the contents of a freshly laid or mature egg of *A. hypnorum* and *Physa* sp. in less than one day, and then they crawled through the gelatinous matrix and penetrated other eggs. The first stadium lasted two to three days. By the second day the larva had developed to such a size that its posterior spiracles could be extended above the surface of the mass. During laboratory rearings many egg masses were so heavily infested that the crowded conditions forced even first instar larvae to move from one mass to another. The low numbers of fly eggs on each snail egg mass in nature (usually only one or two and never more than four) suggest that the first and second stadia normally are completed in the egg mass upon which the fly eggs were laid. This is suggested also by the discovery in nature of an egg mass of *A. hypnorum* containing one first-instar exivium and a second-instar larva which subsequently left the original egg capsule and entered a second just after it molted to the third-instar. A larva consumed 75 eggs in eleven egg masses of *A. hypnorum* between hatching on August 6 and forming a puparium on August 20 (B. A. Foote, pers. comm.).

Eggs and larvae were collected in nature on June 5 and 20. Of 19 egg masses of *A. hypnorum* found on moist, dead leaves and on the damp soil of the vernal pools on May 5, nine were not infested; one bore one embryonated fly egg; one contained one first-instar larva; two contained one second-instar larva each; three had two.

three, and four second-instar larvae; and three each had one third-instar larva. Two third-instar larvae were found crawling amongst living and dead *A. hypnorum* which had congregated at the damp bases of *Carex* near the center of the dried-up vernal pond on June 20. These larvae continued to eat eggs of *A. hypnorum* and *Physa* and mature *A. hypnorum* snails in the laboratory.

Larvae ate only eggs of *A. hypnorum* and *Physa* sp. (and occasionally eggs of *L. palustris*) during the two to three days of the second stadium. During the 10 to 30 days (usually about 15 days) of the third stadium, the larvae were noticeably more active and continued to show a strong predilection for egg capsules of *A. hypnorum* and *Physa* sp. However, third-instar larvae also killed and ate juvenile to mature *A. hypnorum* snails (fig. 3) (but not *Physa* sp., *L. palustris*, or *Helisoma trivolvis* (Say)). The larvae penetrated between the mantle and shell of the snail, killed the prey within a few hours, and consumed most of the tissues during the next 24 to 36 hours.

Newly-laid eggs of the palearctic species, *Antichaeta analis*, contain a thoroughly dispersed pinkish pigment which becomes concentrated in the gut as the embryo develops but disappears by the end of the second larval stadium (Knutson, 1966). Eggs of *A. melanosoma* obtained in Montana were pinkish (B. A. Foote, pers. comm.), but newly laid eggs of *A. melanosoma* from New York did not contain such pigment. However, a pinkish color began to appear in the posterior half of the gut of the larvae from New York at the beginning of the second stadium, and it developed and faded several times during the second and third stadia. Larvae often defecated a small amount of pinkish liquid when they were manipulated with a brush or otherwise disturbed. The color could be seen best in larvae fed on eggs of snails, but it was present also in the guts of larvae which ate mature snails. Flaccid, starved larvae as well as replete individuals often appeared pink. Exposure to a temperature of 5 C did not seem to influence the presence or absence of the pigment. The pink pigment is not an artifact of the laboratory environment or diet; some larvae collected in nature also were pink. We noted that the meconial fluid excreted by newly emerged adults also is bright pink; the meconial fluid produced by other Sciomyzidae is white.

Larvae formed their puparia on, in, and under damp cotton in the rearing boxes. Larvae which hatched from eggs in the laboratory on May 22 pupated between June 7 and 13; a larva collected on June 5 pupated in the laboratory on June 16; and larvae collected on June 20 formed puparia on July 20. The puparia were held at 76% relative humidity and room temperatures. All puparia appeared to contain living pupae, none molded or collapsed, but none produced flies.

Dr. B. A. Foote has provided me with the following information based on rearings carried out in northwestern Montana. "One of eight

puparia produced an adult female on September 10, 1966 after a pupal period of 13 days. Five of the remaining seven puparia produced adults after being refrigerated between October 19, 1966 and February 13, 1967. They had been continuously exposed to room temperatures for 52–62 days before being refrigerated. Adults emerged 15–18 days after being removed from the refrigerator.”

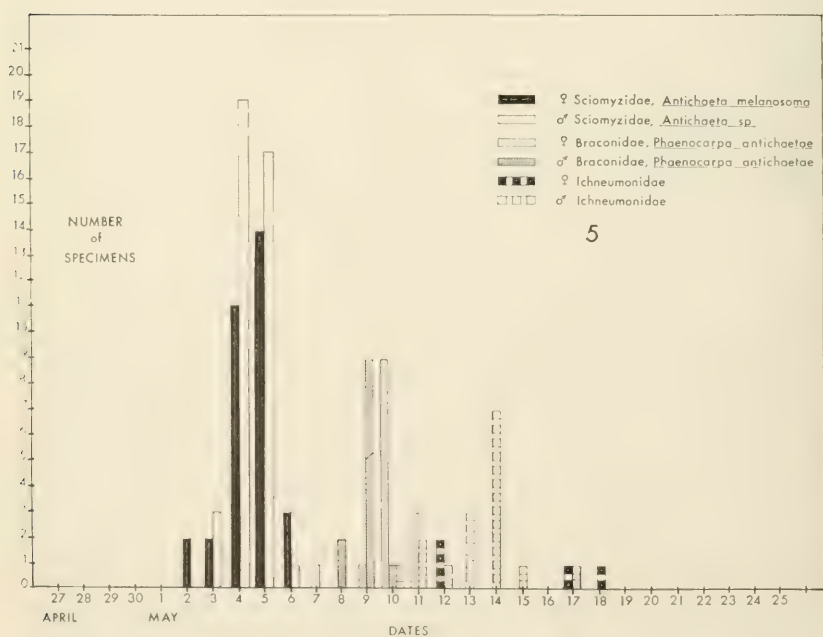
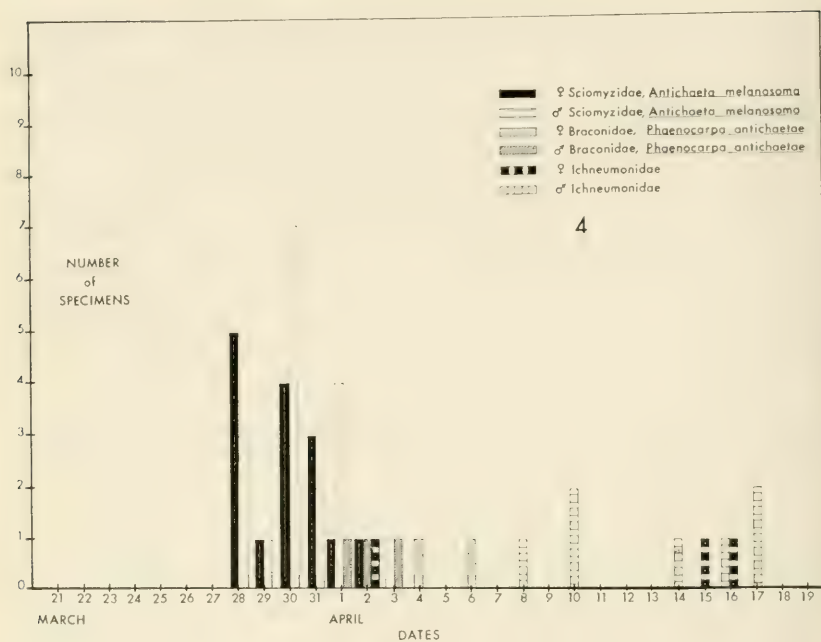
Puparia have been found in vernal situations between March 21 and May 11 at several places in central New York. These puparia produced adults between March 28 and May 16, 3 to 39 days (at room temperature) after they were collected. An apparently viable puparium was washed from plant debris collected from the bottom of the dried vernal pond on October 9, 1965, but did not produce an adult.

Adults were moderately long lived in the laboratory. Field-collected adults lived 4 to 62 days (8 females, 4 to 62 days; 1 male, 14 days). Adults which emerged in the laboratory lived 11 to 59 days (4 females, 11 to 39 days; 4 males, 11 to 59 days).

Dates of capture of adults range from May 11 (Ithaca, New York) to August 10 (Flathead Co., Montana, B. A. Foote), and they also have been taken on July 5 at Umiat, Alaska. *Antichaeta melanosoma* overwinters as a diapausing pupa, and adults emerge after the spring thaws, probably during late April and early May. Because the fly's oviposition sites are limited to egg masses of the food snail, egg laying by the fly probably does not begin until about the middle of May, when the receding waters of the vernal habitats expose suitable oviposition sites for the snails. With 15 to 38 days required for development from deposition of the egg to formation of the puparium, it seems likely that only one generation could be produced before hatching of the last eggs laid by the snails. Failure of puparia formed during June and July to produce adults within the subsequent three months further suggests that there is only one generation per year.

PARASITOID HYMENOPTERA

One species of Braconidae and 6 species of Ichneumonidae have been reared from overwintered puparia of *A. melanosoma* collected in the field. Puparia were collected in New York during early spring, 1966, and were transported to the laboratory for isolation and observation. The collecting site was the wooded, vernal pond at the junction of U. S. 20 and Savage Road, about 5 km west of Geneva. Puparia of *Antichaeta* were collected among floating litter and debris scooped from the pond in buckets. The pond was ice covered during March, at the time of our first collection. Separation of puparia from other materials was done in the laboratory. Individual puparia were placed in separate glass vials fitted with cotton plugs and held in a humid chamber. Vials were examined daily, and emerged adults



were removed for observation in breeding jars or were allowed to feed for 1-2 days before killing and pinning.

Emergence of adult flies and parasitoid wasps from the samples consistently occurred in the following sequence. Flies began emerging 5-7 days after collection, with peak eclosion from days 7 to 9. Braconidae began emerging on day 11, with a peak occurring on day 13. The first Ichneumonidae emerged from days 12 to 13, but their peak emergence occurred much later, at about day 17 (see figs. 4 and 5).

Sequential emergence of parasitic wasps from puparia of *Antichaeta* was first noted in a sample of 56 overwintering puparia collected from the vernal pond on March 21, 1966. All of the flies (33 specimens) emerged from March 28 to April 3. The Braconidae, represented by 5 specimens of *Phaenocarpa antichaetae* Fischer, emerged from April 1 to 6. Nine specimens of Ichneumonidae, representing 3 species, emerged from April 8 to 17. An exception among the Ichneumonidae was a lone female of another species (*Phygadeuon* sp. 2 of W. R. M. Mason) which emerged April 2. This date is toward the end of the period of fly emergence and in the midst of the peak eclosion for Braconidae. (Another specimen of *Phygadeuon* sp. 2 was collected in 1962 at the same locality from a puparium of *A. melanosoma*. The puparium was collected April 14 and a male wasp emerged on April 23.) These findings are summarized in fig. 4.

An even more striking example of sequential emergence was provided by a larger sample of 134 overwintering puparia taken at the same location on April 27, 1966. Between May 2 and 7, 72 adults of *Antichaeta* emerged. Of the Braconidae, 25 *Phaenocarpa antichaetae* emerged from May 8 to 11. The same 3 species of Ichneumonidae (20 specimens) emerged from May 10 to 18 (fig. 5). As in the first collection, there was a slight overlap of Braconidae and Ichneumonidae, with members of both families emerging on the same day. On May 10, a male of *Mesoleptus* (sp. 3 of W. R. M. Mason) was the only ichneumonid to emerge; there were 10 Braconidae produced that day. On May 11, 3 female Braconidae and 2 male Ichneumonidae emerged. By May 12, female Ichneumonidae were emerging along with males, but no additional Braconidae appeared. Most Braconidae and Ichneumonidae emerged in well-defined peaks separated by about 4-5 days.

←

Fig. 4, emergence pattern of Sciomyzidae, Braconidae, and Ichneumonidae from overwintering puparia of *Antichaeta melanosoma* collected March 21, 1966. Fig. 5, emergence pattern of Sciomyzidae, Braconidae, and Ichneumonidae from overwintering puparia of *Antichaeta* spp. collected April 27, 1966. The male fly that emerged on May 7 was *A. borealis* Foote. All other flies and puparia were *A. melanosoma*.

Braconidae

Phaenocarpa antichaetae was described from specimens reared in this study (Fischer, 1974), and the species is known only from the pond west of Geneva. All of the Braconidae reared from puparia were this species.

About 1% of the puparia from our March collection were parasitized by *P. antichaetae*. In the April collection, about 21% of the puparia were parasitized by *P. antichaetae*. Three adults (one female and two males) from the March collection were placed in breeding jars after emergence. They fed readily on a mixture of brewer's yeast, powdered milk, and honey. However, mating was never observed, and the female did not oviposit into larvae of Sciomyzidae placed in the jar. Adults lived 3–19 days in the laboratory (one female, 6 days; 2 males, 3 and 19 days). The sex ratio of emerged *P. antichaetae* was almost exactly 1:1.

Ichneumonidae

The Ichneumonidae reared from the fly puparia represented 6 species in 3 genera. All are undescribed, but 4 species were assigned identification numbers by W. R. M. Mason of Agriculture Canada, who kindly made the determinations during 1967. All 6 species are members of the tribe Hemiteliini, subfamily Cryptinae.

A male of a new species (questionably placed in the genus *Mastrus*) emerged April 8 from a puparium collected March 21. He fed readily on the same artificial food as did *P. antichaetae* and lived 25 days in the laboratory. A female of this new species emerged May 12 from a puparium collected April 27. Other species of *Mastrus* parasitize a great variety of hosts, including Lepidoptera and Hymenoptera (Diprionidae, Tenthredinidae, and Ichneumonidae) (Townes and Townes, 1951).

Mesoleptus sp. 3 was the most common ichneumonid parasitizing *Antichaeta*. Three males were obtained from the March collection and 14 males and one female emerged from puparia collected April 27. Another species of *Mesoleptus* (*[M. declivus (Prochancer)]*) has been reported parasitizing Sciomyzidae in New York. Ashmead (1901) described it as *Atractodes sepedontis* reared from a puparium of *Sepeidon fuscipennis*.

In 1966, only 1 specimen of *Phygadeuon* sp. 2 emerged from puparia of *Antichaeta melanosoma*. A female emerged April 2 from a puparium collected March 21 and lived only 3 days in the laboratory. *Phygadeuon* sp. 7 was rather common. Twelve specimens were collected: 3 males and 2 females from the March 21 collection and 5 males and 2 females from the April 27 collection. Thus the ratio of males to females was 2:1. A female of this species lived 40 days in the labora-

tory. *Phygadeuon*, like *Mesoleptus*, parasitizes muscoid Diptera. It has been reared from Anthomyiidae, Sciomyzidae, Tephritidae, Tachinidae, and Muscidae (Townes and Townes, 1951; Disney, 1964; Fisher and Orth, 1964; Walkley, 1967).

In addition to the four above species, two additional species of Ichneumonidae have been obtained from overwintering puparia of *A. melanosoma* during earlier collections in New York. *Mesoleptus* sp. near *declivus* emerged May 6, 1962 from a puparium collected at the pond west of Geneva on April 28. *Phygadeuon* sp. 1 near *trichops* was represented by three specimens; two puparia collected April 28, 1962, from the pond west of Geneva produced wasps on May 8 and 14; a puparium collected at Brooktondale on April 14, 1962, produced another specimen on May 6.

DISCUSSION

The particularly close associations that have developed among the snail host *Aplexa hypnorum*, the fly *Antichaeta melanosoma*, and the seven species of parasitoid wasps exhibit a close correlation with each other at all stages of the life cycles and also with fluctuations in their ephemeral habitat. This correlation begins with the exposure of egg capsules of *A. hypnorum* as the water level drops and as females of *A. melanosoma* seek oviposition sites, continues with egg-laying wasps searching for suitable larvae or pupae for parasitization, and finishes with the final pupation of *A. melanosoma* in the moist areas that still remain in the habitat. Larvae of *A. melanosoma* are protected from desiccation by continuing to feed on moist snail tissues when vernal ponds have dried up. They further escape dessication by the behavior of the host snail which usually seeks damp places. It is likely that during this time larvae or even pupae are most susceptible to parasitization by Braconidae and Ichneumonidae. The fact that as many as seven species of wasps oviposit into *A. melanosoma* indicates that the fly is probably easily and frequently exposed to parasitization. Townes (1971) reports that ovipositing females of Ichneumonidae are attracted to microhabitats where suitable hosts may be found. O'Neill (1973) generally found the same to be true for two species of parasitoid Hymenoptera in the family Diapriidae.

A further example of the close association of *A. melanosoma* with its vernal pool habitat is a pupal diapause preventing emergence until the following spring. Only one generation is produced each year. The wasp parasitoids of *A. melanosoma* also probably undergo a diapause, or at least a quiescent period, since they too emerge in the spring at a time when different age classes of host larvae or pupae are present in which to lay their eggs. Griffiths (1964) reported that

braconid parasites of Agromyzidae emerge from puparia from a few days up to two or three weeks later than the host flies, thus allowing an availability of host larvae at the time of mating and egg-laying.

The further sequential emergence pattern exhibited by the well-defined peaks separating Braconidae from Ichneumonidae suggests that an isolating mechanism to restrict or limit competition may be operating in this vernal habitat. The diminution of competition for the same resource (i.e., host flies) and the adaptation to different ecological niches on a temporal plane may permit coexistence among these species of parasitoid wasps.

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FIRST RECORDS OF MEONEURA VAGANS FROM THE NORTHEASTERN UNITED STATES (DIPTERA: MILICHIIDAE)

The filth fly genus *Meoneura* is represented in the Nearctic Region by 13 species, many known only from one or a handful of localities (Sabrosky 1965, In Stone, *et al.*, USDA Agr. Hdbk. 276:728-733). Six of the species, including *M. vagans* (Fallén), are Holarctic. The genus was poorly known in North America until recently, when Sabrosky (1959, Ann. Entomol. Soc. Amer. 52: 17-26) revised the Nearctic species, describing 5 as new and recording 4 for the first time from North America. Later, Sabrosky (1961, Entomol. News. 72:229-234) described *M. californica* from the United States.

Collin (1930, Entomol. Mon. Mag. 66:82-89) collected adults of *M. vagans* on carrion and stated that this species was common in several areas in England. Sabrosky (1959) recorded *M. vagans* in North America only from Isle Royale, Michigan (1 male and 1 female collected 3-7 August 1936), and since that time no reports of additional collections have appeared.

On 17-18 June 1976, I collected 21 adults (20 males, 1 female) of *M. vagans* in Hummelstown, Dauphin County, Pennsylvania, sweeping over the body of a dead snapping turtle at the edge of a woodland. In November 1976, I received from L. L. Pechuman and J. A. Schafrik, Cornell University, a female fly collected at Ithaca, New York, 4 August 1925 and determined as *M. vagans* by S. W. Frost. I compared this specimen with my lone female and tentatively confirmed Frost's determination. Curtis W. Sabrosky kindly examined the specimen, compared it with American and European material of *vagans*, and agreed with my conclusion.

These records represent a considerable range extension for *M. vagans* in North America. The small size of many filth flies and their rather restricted habits are probably responsible for the paucity of collection records. The specimens of *M. vagans* are deposited in the collections of the U.S. National Museum of Natural History, Washington, DC; Cornell University, Ithaca, NY; and the Pennsylvania Department of Agriculture, Harrisburg, PA.

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A REVISION OF THE NEARCTIC SPECIES OF JENKINSHELEA MACFIE (DIPTERA: CERATOPOGONIDAE)

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ABSTRACT—The 4 species of *Jenkinshelea* Macfie known to inhabit North America are described and illustrated, and a key is provided for identification. Two species are new, *J. stonei* and *J. blantoni*, and 2 species groups are recognized, the *albaria* group and *magnipennis* group.

Jenkinshelea Macfie is a small genus of biting midges presently known from 8 species in Africa, Asia, New Guinea, and North America. Wirth (1962a) reviewed the North American species and (1962b) provided some interesting biological data on the pupae of *J. albaria* (Coquillett). Recent collecting in Florida and Texas has resulted in many additional specimens including 2 new species here described.

In the present paper we provide illustrations and keys for the 4 known Nearctic species and recognize 2 species groups. We have found that males of each Nearctic species have distinctive genitalia that facilitate their identification. Females are less distinct, being easy to key to the species group level but much more difficult to determine to species, especially where the ranges of two closely related species overlap. In these instances, we have been able to separate them by differences in size only, making determination of pinned specimens difficult if not impossible.

MATERIALS AND METHODS

Unless otherwise indicated all specimens examined are on slides and are part of the collection of the National Museum of Natural History (USNM) in Washington, where the types of the new species will be deposited. Paratypes will be deposited in the British Museum (Natural History), London; the Canadian National Collection (CNC), Ottawa; the California Academy of Sciences (CAS), San Francisco; and Cornell University (CU), Ithaca, New York.

For general terminology of Ceratopogonidae see Wirth (1952); terms dealing with male genitalia follow Snodgrass (1957). Unless otherwise indicated measurements and other data are based on specimens mounted on slides in the manner of Wirth and Marston (1968). When possible 10 females of each species were measured and the data presented in the following manner: mean (minimum value–maximum value, n = number of measurements); for new

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species actual values are given for the allotype, and the mean, minimum-maximum, and sample size are given in the variation section. The following special terms are used in the description of females: wing length is measured from the basal arculus to the wing tip; antennal proportions (AP) are the relative lengths of the flagellomeres and antennal ratio (AR) is the value obtained by dividing the combined lengths of the proximal 8 flagellomeres into the combined lengths of the distal 5 flagellomeres.

Genus *Jenkinshelea* Macfie

Jenkinsia Kieffer, 1913:161. Type-species, *Jenkinsia setosipennis* Kieffer (original designation). Preoccupied by *Jenkinsia* Jordan and Evermann, 1896.

Jenkinshelea Macfie, 1934:177 (new name for *Jenkinsia* Kieffer). Type-species, *Jenkinsia setosipennis* Kieffer (automatic).

Diagnosis: A genus of large, usually grayish pollinose Sphaeromiine biting midges that can be distinguished from other ceratopogonid genera by the following combination of characters: Anal angle of female wing greatly expanded; wing with 2 radial cells, in the female the 2nd radial cell elongated with the costa nearly reaching wing tip, in males 2nd radial cell extending to 0.75 of wing length; aedeagus of males lacking well-developed basal arms and the anterior margin usually truncate or rounded.

Description: Body slender, usually pollinose, nearly bare. Eyes broadly separated, bare. Palpus slender, 5 segmented; 3rd segment with scattered sensilla but lacking well-defined pit. Female antenna with proximal 8 flagellomeres elongate, distal 5 more elongate; male antenna with distal 3 flagellomeres elongate, plume moderately developed. Scutum without anterior spine or tubercle, broadly rounded anteriorly. Legs slender, unarmed; 4th tarsomere cordiform; 5th tarsomere slender, in female armed ventrally with several stout batonnets, in male unarmed; claws of female equal, each with blunt basal external tooth; claws of male small, equal, with bifid tips, and lacking basal tooth. Wing broad in female with greatly expanded anal angle, narrower in male with anal angle normal; surface with microtrichia only; 2 radial cells present, 2nd greatly elongated in female, nearly reaching wing tip, in male extending to 0.75 of wing length; r-m crossvein long, perpendicular, usually infuscated; media broadly sessile. Female abdomen with sterna and terga fused on segments 8 and 9, forming subcylindrical structures; venter of segment 8 deeply cleft posteriorly with apical dense long setae; 10th sternum with apical pair of large setae; 2 well-developed spermathecae present. Male genitalia elongate; 9th tergum slender, tapering distally with pubescent short cercus; basimere extremely long and slender, telomere long and curved distally; aedeagus fairly short, rounded or truncate on anterior margin, apex usually rounded, lacking well-developed basal arms; claspettes fused, basal arms well developed, distal portion divided, the tips usually slender and bent ventrad.

Immature Stages: Larvae are unknown but are presumed to inhabit the substrate of aquatic situations where they are probably predaceous. Pupae float in water and can be collected along the margins

of streams and ponds where emergence of the adults occurs. Known pupae have membranous ventral adhesive discs on abdominal segments 6 and 7. Just prior to eclosion, pupae climb up emergent vegetation or other available objects to above the water line and attach themselves to these objects with an adhesive fluid from these discs.

Adult Habits: Adults can be collected on vegetation bordering aquatic habitats and are attracted to light traps. Adult feeding habits are unknown but by analogy from related genera females are presumed to prey upon small nematocerans.

Relationships: *Jenkinshelea* is most closely related to the genus *Crispomyia* Debenham (1974) from Australia. Males of *Crispomyia* are unknown but females can be differentiated from those of *Jenkinshelea* on the basis of the following characters:

<i>Jenkinshelea</i>	<i>Crispomyia</i>
Eyes broadly separated	Eyes contiguous
Palpus 5-segmented	Palpus 4-segmented (4 & 5 fused)
Fourth tarsomeres cordiform	Fourth tarsomeres cylindrical
Wing with 2 radial cells	Wing with 1 radial cell
Costal ratio 0.98	Costal ratio 0.84-0.89

KEY TO THE NEARCTIC SPECIES OF JENKINSHELEA MACFIE

1. Females 2
- Males 5
2. Abdominal segments 8 and 9 each with a pair of ventrolateral spinelike sclerotized tubercles; tibiae usually extensively yellowish (*albaria* group) 3
- Abdominal segments 8 and 9 without a pair of ventrolateral spinelike sclerotized tubercles; tibiae blackish (*magnipennis* group) 4
3. Wing length 2.7-3.5 (mean 3.08) mm; antennal ratio 1.27-1.40 (mean 1.34) *albaria* (Coquillett)
- Wing length 2.1-2.8 (mean 2.56) mm; antennal ratio 1.20-1.28 (mean 1.24) *stonei* new species
4. Wing length 3.6-4.0 (mean 3.84) mm; northeastern U.S. and southern Canada *magnipennis* (Johannsen)
- Wing length 2.5-3.3 (mean 3.07) mm; Florida only *blantoni* new species
5. Aedeagus twice as long as broad (*albaria* group) 6
- Aedeagus 1.5 times as long as broad (*magnipennis* group) 7
6. Distal portion of claspettes with long, slender, divergent tips *albaria* (Coquillett)
- Distal portion of claspettes with short, blunt, greatly appressed tips *stonei* new species
7. Aedeagus with rounded tip; distal portion of claspettes with very long, straight, slender, greatly divergent tips *magnipennis* (Johannsen)
- Aedeagus with pointed, bifid tip; distal portion of claspettes with apex bent 90 degrees *blantoni* new species

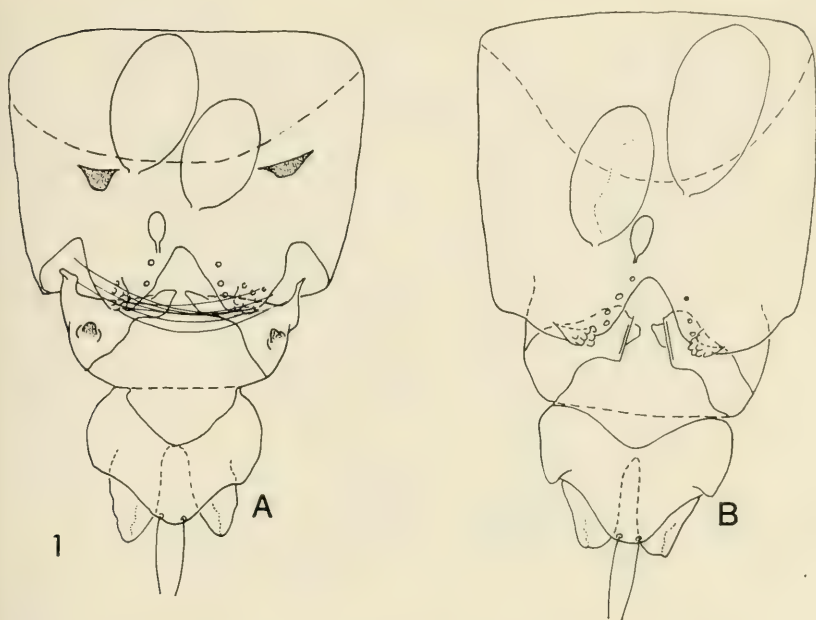


Fig. 1, genitalia of female *Jenkinshelea* spp. A, *J. albaria*. B, *J. blantoni*.

ALBARIA GROUP

Females with abdominal segments 8 and 9 each with a pair of ventrolateral spinelike sclerotized tubercles; tibiae usually extensively yellowish. Males with aedeagus twice as long as broad, base truncate or slightly rounded, basal arms reduced or absent.

Jenkinshelea albara (Coquillett)

fig. 1A, 2, 3A, 7A-D

Ceratopogon albarius Coquillett (as *albaria*), 1895:308 (female; Florida).

Johannsenomyia albaria (Coquillett); Malloch, 1915:335 (Illinois; synonym of *Johannsenomyia magnipennis* (Johannsen).

Jenkinshelea albaria (Coquillett); Johannsen, 1943:783 (combination; listed from e. U.S.); Wirth, 1962a:1 (redescription; key; fig. male genitalia); Wirth, 1963:137 (distribution).

Johannsenomyia aequalis Malloch, 1915:336 (male; Illinois); Johannsen, 1943:378 (listed from New York); Wirth, 1962a:2 (synonym of *J. albaria*).

Diagnosis: Males distinguished from all other Nearctic *Jenkinshelea* by their claspettes with long, slender, divergent tips and aedeagus nearly twice as long as broad. Females distinguished from all other *Jenkinshelea* except *J. stonei* by the pair of ventrolateral spinelike



Fig. 2, North American locality records for *Jenkinshalea albaria*.

sclerotized tubercles on abdominal segments 8 and 9; from *J. stonei* by their larger size, wing length 2.75–3.53 (mean 3.08) mm, and greater antennal ratio, 1.27–1.40 (mean 1.34).

Female: Wing length 3.08 (2.75–3.53, $n = 14$) mm; breadth 1.38 (1.15–1.60, $n = 12$) mm. *Head*: Brown; palpus light brown; vertex grayish pollinose in pinned specimens. Antennal pedicel dark brown; AP 19-10-10-11-11-11-11-21-23-24-25-33; AR 1.34 (1.27–1.40, $n = 13$). Mandible with 7, rarely 8 teeth. *Thorax*: Scutum, scutellum, postscutellum, and pleuron brown; grayish pollinose in pinned specimens. Legs with 2 usual color patterns; a dark form with coxae, trochanters, femora, mid and hind tibiae brown, fore tibia lighter brown; the more common form with fore coxa, trochanters, fore femur, proximal $\frac{3}{4}$ of mid and hind femora, fore tibia, and broad subapical bands on mid and hind tibia yellowish to light brown; dark brown on mid and hind coxae, fore femorotibial joint, distal $\frac{1}{4}$ of mid and hind femora, and proximal $\frac{1}{2}$ and apex of mid and hind tibiae; tarsi of both forms pale on tarsomeres 1 and 2, brown on 3–5. Wing as in *J. magnipennis* (fig. 5D). Halter stem pale to light brown; knob white. *Abdomen*: Dorsum whitish except segments 8 and 9 brown; venter reddish brown. Genitalia as in fig. 1A. Eighth segment with pair of large ventrolateral spinelike sclerotized tubercles at midlength; anterior margin truncate, posterior margin with deep cleft. Ninth segment with pair of smaller ventrolateral spine-like sclerotized tubercles at midlength; anterior margin cleft, lobes directed

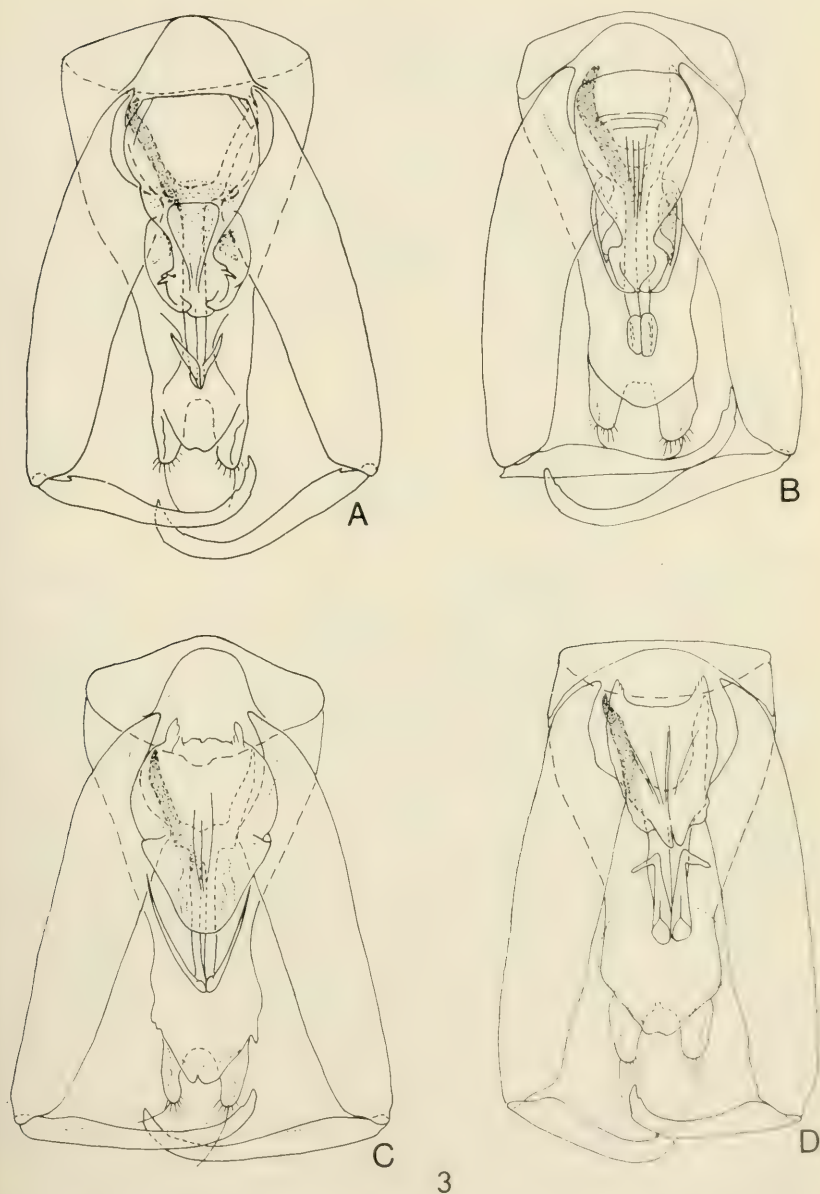


Fig. 3, genitalia of male *Jenkinshalea* spp. A, *J. albaria*. B, *J. stonci*. C, *J. magnipennis*. D, *J. blantoni*.



Fig. 4. North American locality records for *Jenkinshelea stonei*.

slightly anterad. Tenth sternum with pair of large apical setae. Spermathecae ovoid, subequal with short necks.

Male: Smaller, similar to female with following differences: Femora and tibiae entirely brown; halter brown. Genitalia as in fig. 3A. Ninth sternum about twice as broad as long, base nearly straight with a deep caudomedian excavation; 9th tergum tapering gradually on proximal $\frac{1}{2}$, distal $\frac{1}{2}$ tapering slightly with round tip; cercus short, not reaching apex of basimere. Basimere very slightly curved, about 4 times longer than broad; telomere slightly more than $\frac{1}{2}$ the length of basimere, tapering slightly distally with distal $\frac{1}{2}$ greatly curved, nearly hooked. Aedeagus nearly twice as long as broad; base truncate; proximal portion with transverse wrinkles distally; distal portion with distinct peglike sclerotization and with prominent lateral sclerotized lobes. Claspettes fused; basal arm heavily sclerotized, tip curved mesally; distal portion divided, more lightly sclerotized, tips long, slender, divergent, and bent ventrad.

Pupa: Brown. Female operculum (fig. 7A) about as long as broad, surface covered with small rounded tubercles; anterior end rounded, tip pointed; central portion with raised areas bearing pair of tubercles, posterior 1 with single long seta; lateral margins greatly elevated; posterior margin attached. Male operculum similar to that of female but slightly narrower. Respiratory organ (fig. 7B) about 2.5 times longer than broad; surface smooth; apex with double row of 5-8 spiracles. Female terminal segment (fig. 7C) about twice as long as broad; dorsum covered with small pointed tubercles; venter covered with small pointed tubercles except for small circular central area; apicolateral processes moderately divergent, covered with small pointed tubercles. Male terminal segment (fig. 7D) about 1.7 times longer than broad; dorsum covered with small pointed tubercles; venter covered with small pointed tubercles on distal $\frac{1}{2}$, genital processes tightly appressed and very slightly wrinkled; apicolateral processes greatly divergent, covered with small pointed tubercles.

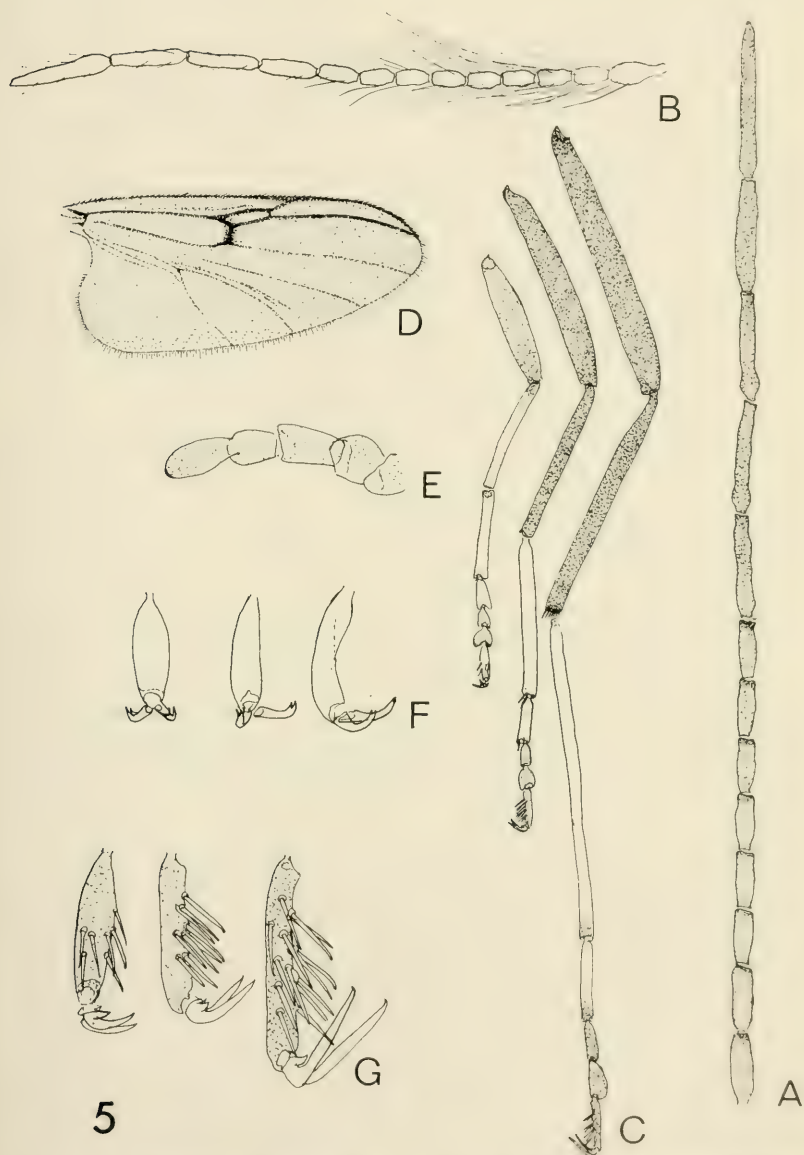


Fig. 5, *Jenkinshalea magnipennis*. A, female flagellum. B, male flagellum. C, female legs. D, female wing. E, female palpus. F, male 5th tarsomeres. G, female 5th tarsomeres.



Fig. 6. North American locality records for *J. magnipennis* (solid circles) and *J. blantoni* (open circles).

Distribution: Ontario south to Florida, west to Texas and Illinois (locality records plotted in fig. 6).

Types: Holotype, ♀, of *Ceratopogon albarius* Coquillett: Drayton Island, Putnam Co., Florida, 9 May 1894, C. W. Johnson Type no. 7431 (MCZ). Holotype, ♂, of *Johannsenomyia aequalis* Malloch: Stony Creek, Muncie, Vermilion Co., Illinois, 5 July 1914, J. R. Malloch (INHS).

New Records: FLORIDA: *Alachua Co.*, Gainesville, 20 April 1967, W. W. Wirth, reared from pond margin, 1 ♂. *Glades Co.*, Palmdale, 14 July 1970, E. Irons, light trap, 1 ♀. *Hardee Co.*, Ona, July 1970, E. Irons, 1 ♀. *Jefferson Co.*, Monticello, April 1969, W. H. Whitcomb, black light trap, 1 ♀. *Sarasota Co.*, Myakka River St. Park, 21 May 1973, W. W. Wirth, light trap, 2 ♀. GEORGIA: *Glynn Co.*, Thalmann (CU). MARYLAND: *Montgomery Co.*, Plummer's Island, 2 July 1915, R. C. Shannon, 1 ♀. PENNSYLVANIA: *York Co.*, Conewago Creek, 1 August 1972, W. W. Wirth, light trap, 1 ♀. TEXAS: *Kerr Co.*, Kerrville, August 1953, L. J. Bottimer, light trap, 2 ♂. *Real Co.*, 5 mi. NW of Leakey, reared from Rio Frio, 23 May 1972, W. W. Wirth, 1 ♂. VIRGINIA: *Fairfax Co.*, Potomac River at Scott Run, 12 July 1976, Wirth and Grogan, 1 pupa. ONTARIO: Constance Bay, 21 July 1967, L. Forster, 2 ♂ (CNC).

Discussion: Wirth (1962b) noted the ventral adhesive discs on segments 6 and 7 of the pupa of this species. He observed that pupae placed in glass vials would climb up the sides of the vials and postulated that pupae would similarly climb up emergent vegetation before

eclosion. All of the pupae examined from Virginia, Florida, and Texas had adhesive discs present.

Jenkinshelea stonei Grogan and Wirth, new species
fig. 3B, 4

Jenkinshelea albaria (Coquillett); Wirth, 1962a:1 (in part; Texas records).

Diagnosis: Males distinguished from all other Nearctic *Jenkinshelea* by their claspettes with short, blunt, greatly appressed tips and aedeagus nearly twice as long as broad. Females distinguished from all other Nearctic *Jenkinshelea* except *J. albaria* by the pair of ventrolateral spinelike sclerotized tubercles on abdominal segments 8 and 9; from *J. albaria* by their smaller size, wing length, 2.13–2.79 (mean 2.56) mm and small antennal ratio, 1.20–1.28 (mean 1.24).

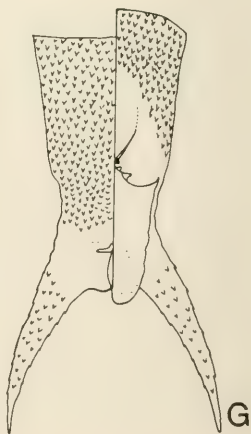
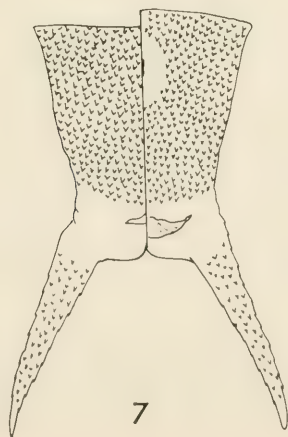
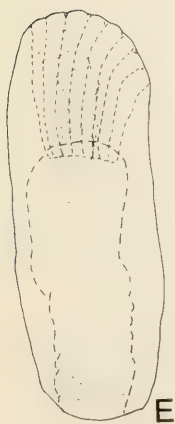
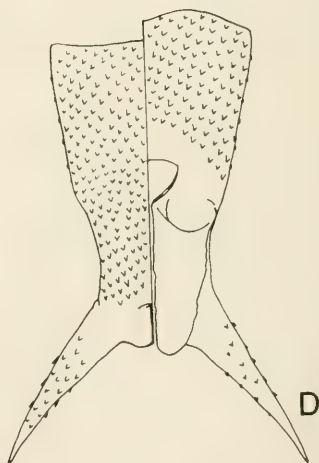
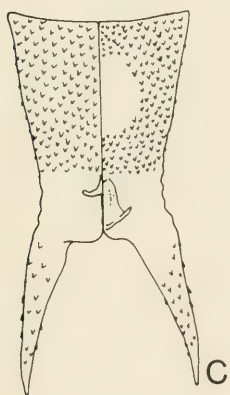
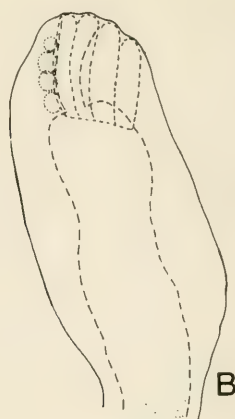
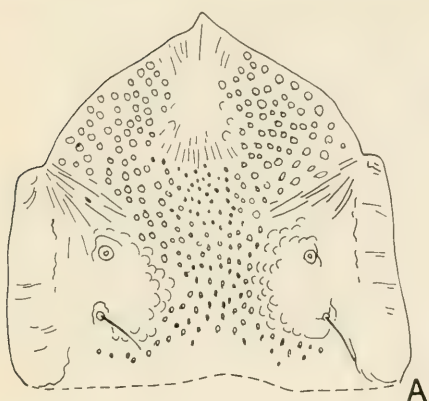
Allotype Female: Wing length 2.79 mm; breadth 1.27 mm. *Head*: Reddish brown; palpus light brown. Antennal pedicel dark brown; flagellum brown; AP 19-10-10-11-12-11-12-13-21-22-25-25-32; AR 1.28. Mandible with 6 large teeth. *Thorax*: Scutum, scutellum, postscutellum, and pleuron dark brown. Fore coxa, trochanters, fore femur, proximal $\frac{2}{3}$ of mid femur, proximal $\frac{1}{2}$ of hind femur, fore tibia, broad subapical band on mid and hind femora, and proximal 2 tarsomeres of tarsi yellowish to light brown; mid and hind coxae, fore femorotibial joint, distal $\frac{1}{3}$ of mid femur and distal $\frac{1}{2}$ of hind femur dark brown; distal 3 tarsomeres brown. Wing as in *J. magnipennis* (fig. 5D). Halter pale; knob brown. *Abdomen*: Light brown; segments 8 and 9 dark brown. Genitalia as in *J. albaria* (fig. 1A).

Holotype Male: Smaller, similar to allotype female with the following differences: Head dark brown; thorax darker brown; femora and tibiae dark brown; halter brown. Genitalia as in fig. 3B. Ninth sternum about 2.7 times broader than long, base nearly straight with deep caudomedian excavation; 9th tergum tapering gradually distally on proximal $\frac{1}{2}$, distal $\frac{1}{2}$ tapering slightly with round tip; cercus short, nearly reaching apex of basimere. Basimere very slightly curved, about 4 times longer than broad; telomere about 0.6 as long as basimere, tapering slightly distally with distal $\frac{1}{2}$ greatly curved, nearly hooked. Aedeagus about twice as long as broad, base nearly truncate; proximal portion with transverse wrinkles proximally, then longitudinal wrinkles distally; distal portion more or less quadrate with prominent lateral sclerotized lobes. Claspettes fused; basal arm heavily sclerotized, tip curved mesally; distal portion divided, more lightly sclerotized with tips short, blunt, greatly appressed and bent ventrad.

Variation: Females: Wing length 2.56 (2.13–2.79, $n = 10$) mm; breadth 1.15 (0.90–1.23, $n = 10$) mm. AR 1.24 (1.20–1.28, $n = 9$). Mandibular teeth 6–9. All of the female paratypes agree with the allotype in form and coloration. All the male paratypes agree with the holotype in form and coloration.

Etymology: This species is dedicated to Alan Stone in recognition of his outstanding leadership in the field of Dipterology in North America.

Distribution: Florida and Texas (locality records plotted in fig. 4).



Types: Holotype, ♂, allotype, ♀, Florida Caverns State Park, Jackson Co., Florida, 26 May 1973, W. W. Wirth, light trap (Type no. 71160, USNM). Topoparatypes, 4 ♂♂, 5 ♀♀; other paratypes 7 ♀♀, 2 ♂♂, as follows: FLORIDA: *Escambia Co.*, Walnut Hill, June 1969, F. S. Blanton, black light trap, 1 ♀. *Leon Co.*, Tall Timbers Res. Sta., 29 May 1973, W. W. Wirth, light trap, 1 ♀. *Orange Co.*, Rock Springs, 21 April 1970, W. W. Wirth, light trap, 2 ♀♀. TEXAS: *Gillespie Co.*, Fredericksburg, 30 June 1967, Blanton and Borchers, light trap, 1 ♀. *Jasper Co.*, Jasper, 2 August 1968, R. E. Woodruff, black light trap, 1 ♀. *Kerr Co.*, Kerrville, August 1953, L. J. Bottimer, 1 ♀, 2 ♂♂.

Discussion: Wirth (1962a) considered the 2 male paratypes from Kerr Co., Texas, as atypical *J. albaria* because of their obvious differences in the tips of their claspettes. He recognized that a possible new species was represented by those specimens but declined to name and describe them at the time because of limited material.

Present records indicate that the ranges of *J. stonei* and *J. albaria* overlap in the extreme southeastern U. S. and they have been taken in the same light trap from Kerr Co., Texas. However, further collections are necessary to determine the degree of sympatry that exists between these 2 closely related species.

MAGNIPENNIS GROUP

Females with abdominal segments 8 and 9 without pairs of ventrolateral spinelike sclerotized tubercles; tibiae blackish. Males with aedeagus 1.5 times longer than broad, base with short basal arms.

Jenkinshelea magnipennis (Johannsen)

fig. 3C, 5, 6, 7E-G

Johannseniella magnipennis Johannsen, 1908:268 (male; New York).

Jenkinshelea magnipennis (Johannsen); Wirth, 1962a:3 (redescription; key; fig. male genitalia); Wirth, 1965:137 (distribution).

Diagnosis: Males distinguished from all other Nearctic *Jenkinshelea* by their aedeagus 1.5 times longer than broad with round tip and short submarginal basal arms, and claspettes with very long, slender, straight, greatly divergent tips. Females distinguished from all other Nearctic *Jenkinshelea* except *J. blantoni* by the lack of spinelike tubercles on the venter of abdominal segments 8 and 9; from *J. blantoni* by their larger size, wing length 3.61-4.02 (mean 3.84) mm.

←

Fig. 7, pupae of *Jenkinshelea* spp. A-D, *J. albaria*. E-G, *J. magnipennis*. A, operculum, B and E, respiratory organs, C and F, female terminal segments, D and G, male terminal segments.

Female: Wing length 3.84 (3.61–4.02, $n=10$) mm; breadth 1.63 (1.56–1.68, $n=9$) mm. *Head*: Brown; palpus (fig. 5E) light brown; vertex grayish pollinose in pinned specimens. Antennal pedicel dark brown; flagellum (fig. 5A) brown, lighter brown occasionally on proximal 8 flagellomeres; AP 24-13-13-13-14-14-14-25-27-26-30-38; AR 1.27 (1.19–1.31, $n=8$). Mandible with 7, rarely 8 teeth. *Thorax*: Dark brown; grayish pollinose in pinned specimens. Legs (fig. 5C) with coxae, trochanters, femora and tibiae dark brown; tarsi pale on proximal 2 tarsomeres, distal 3 tarsomeres brown; 5th tarsomeres (fig. 5G) with several ventral batonnets, hind claws longer than mid, mid claws longer than fore. Wing (fig. 5D) hyaline; veins light brown, membrane milky whitish on proximal $\frac{1}{3}$, pale smoky brown on distal $\frac{2}{3}$; r-m crossvein infuscated dark brown. Halter pale to brown. *Abdomen*: Dorsum whitish except brown on segments 8 and 9; venter reddish brown. Genitalia as in *J. blantonii* (fig. 1B).

Male: Smaller, similar to female with the following differences: Flagellum (fig. 5B) entirely brown; 5th tarsomeres (fig. 5F) lacking ventral batonnets, claws small, equal, tips bifid; abdomen entirely brown. Genitalia as in fig. 3C. Ninth sternum about 2.3 times broader than long, base slightly curved with a deep caudomedian excavation; 9th tergum tapering gradually on proximal $\frac{1}{2}$, distal $\frac{1}{2}$ broadening slightly to rounded tip; cercus short, not quite reaching apex of basimere. Basimere straight, about 4.5 times longer than broad; telomere slightly more than $\frac{1}{2}$ the length of basimere, tapering slightly distally with last $\frac{1}{4}$ greatly curved. Aedeagus about 1.5 times longer than broad; base slightly rounded with short submarginal basal arms; proximal $\frac{1}{2}$ with light wrinkles, transverse mesally, longitudinal marginally; distal $\frac{1}{2}$ with strong longitudinal wrinkles, tip rounded. Claspettes fused; basal arm heavily sclerotized, tip curved slightly mesally; distal portion divided, more lightly sclerotized, tips very long, slender, straight, greatly divergent and bent ventrad.

Pupa: Dark brown. Female and male operculum nearly identical with those of *J. albaria* (fig. 7A). Respiratory organ (fig. 7E) about 3 times longer than broad; surface smooth; apex with double row of about 15 spiracles. Female terminal segment (fig. 7F) about 1.5 times longer than broad; dorsum covered with small pointed tubercles; venter covered with small pointed tubercles except for small central area; apicolateral processes greatly divergent, covered with small pointed tubercles. Male terminal segment (fig. 7G) about twice as long as broad; dorsum covered with small pointed tubercles; venter covered with small pointed tubercles, genital processes greatly appressed and slightly wrinkled; apicolateral processes moderately divergent, covered with small pointed tubercles.

Distribution: Maine west through Quebec and Ontario to British Columbia, south to central Illinois and New York (locality records plotted in fig. 6).

Type: Holotype, ♀, Old Forge, Herkimer Co., New York, 20 Aug. 1905, J. G. Needham (CU).

New Records: BRITISH COLUMBIA: Wasa Lake, 17 July 1974, P. H. Arnaud, Jr., 5 ♀♀, 8 ♂♂ (CAS). NEW YORK: *Cayuga Co.*, Auburn, July 1970, R. C. Miller, prey in nest of *Lindenius c. errans* (Fox), 1 ♀, 10 ♂♂ (pinned). QUEBEC: Abbotsford, 5 July 1936, G. E. Shewell, 1 ♀ (CNC); St. Pierre de Wakefield, 19 June 1974, L. Forster, 6 ♂♂ (CNC). ONTARIO: Black Lake, Stanleyville, 25 June–3 July 1967, J. A. Downes, 1 ♀, 2 ♂♂ (CNC).

25–29 August 1975, W. L. Grogan, Jr., reared from lake margin, 11 ♀♀, 7 ♂♂; Ottawa, 28 July 1939, O. Peck, 5 ♀♀, 1 ♂ (CNC).

Discussion: Grogan reared a large series of *J. magnipennis* from pupae at Black Lake, Ontario, during late June, 1975. Pupae were collected as they crawled up the sides of a painted wooden rowboat along the margin of the lake. Several adults were seen emerging after the pupae had secured themselves to the surface of the boat above the water line. It is suspected that pupae do not crawl out of the water until just before eclosion. Pupae placed in glass vials would climb up the sides of the vials and cement themselves to the glass with an adhesive fluid secreted by their membranous abdominal discs. This behavior is identical to that seen in *J. albaria* by Wirth (1962b). All of the pupae examined by us from Black Lake and Ottawa, Ontario had ventral discs present on abdominal segments 6 and 7.

Jenkinshelea blantoni Grogan and Wirth, new species
fig. 1B, 3D, 6

Diagnosis: Males distinguished from all other Nearctic *Jenkinshelea* by their aedeagus 1.5 times longer than broad with a pointed bifid tip and short marginal basal arms, and claspettes with tips bent at 90 degrees. Females distinguished from all other Nearctic *Jenkinshelea* except *J. magnipennis* by the absence of spinelike tubercles on the venter of abdominal segments 8 and 9; from *J. magnipennis* by their smaller size, wing length 2.46–3.32 (mean 3.07) mm.

Allotype Female: Wing length 3.32 mm; breadth 1.47 mm. *Head*: Dark brown; palpus light brown except 5th segment brown. Antennal pedicel brown; flagellum brown; AP 19-11-11-12-12-12-12-24-25-25-24-28; AR 1.25. Mandible with 7 large teeth. *Thorax*: Scutum, scutellum, postscutellum, and pleuron dark brown. Legs dark brown; distal $\frac{1}{2}$ of fore coxa, fore and mid trochanters, bases of fore and hind femora, proximal $\frac{1}{3}$ of mid femur, venter of fore tibia, subapical band on mid tibia, and distal 3 tarsomeres of tarsi lighter brown; proximal 2 tarsomeres of tarsi pale. Wing as in *J. magnipennis* (fig. 5D). Halter stem light brown; knob darker brown. *Abdomen*: Light brown except for terminal 3 segments; internally dark reddish brown. Genitalia as in fig. 1B. Venter of segments 8 and 9 lacking spinelike tubercles; venter of 8th segment with deep caudomedian notch. Ninth segment divided ventrally, each $\frac{1}{2}$ with pointed, mesally directed tip. Tenth sternum with pair of large apical setae. Spermathecae ovoid, subequal with short necks.

Holotype Male: Smaller, similar to allotype female with the following differences: Coxae, trochanters, femora and tibiae entirely brown; halter brown. Genitalia as in fig. 3D. Ninth sternum about 4 times broader than long, base straight with broad shallow caudomedian excavation; 9th tergum tapering gradually distally on proximal $\frac{2}{3}$, distal $\frac{1}{3}$ broadening slightly with rounded tip; cercus short, extending far short of apex of basimere. Basimere straight, about 4.5 times longer than broad; telomere about 0.4 times length of basimere.

tapering slightly distally, distal $\frac{1}{3}$ greatly curved. Aedeagus almost 1.5 times longer than broad; base concave with short marginal basal arms; mesal portion with strong longitudinal wrinkles; distal portion with truncate margins, tip divided with each portion pointed. Claspettes fused; basal arm heavily sclerotized, nearly straight; distal portion more lightly sclerotized, bent ventrad, moderately divergent with tips bent 90 degrees.

Variation: Females: Wing length 3.07 (2.46–3.32, $n = 10$) mm; breadth 1.31 (1.03–1.47, $n = 9$) mm. AR 1.29 (1.19–1.42, $n = 10$). All of the female paratypes agree with the allotype in form and coloration. All of the male paratypes agree with the holotype in form and coloration.

Etymology: This species is named for Franklin S. Blanton who collected the type-series and in recognition of his contributions to the study of North American Ceratopogonidae.

Distribution: Florida (locality records plotted in fig. 6).

Types: Holotype, ♂, allotype, ♀, Lon's Lake, Putnam Co., Florida, May 1971, F. S. Blanton, black light trap (Type no. 71161, USNM). Topoparatypes, 20 ♀♀, 34 ♂♂; other paratypes, 4 ♀♀, 1 ♂, as follows: FLORIDA: *Polk Co.*, Lake Alfred, October 1952, M. H. Muma, 1 ♀. *Santa Rosa Co.*, Blackwater A. and M. Biological Station, 21 May 1971, G. B. Fairchild, black light trap, 2 ♀♀. *Wakulla Co.*, Ocklokonnee River St. Park, 29 April 1970, W. W. Wirth, light trap, 1 ♀, 1 male.

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A NEW *LESPESIA* CONFUSED WITH *L. ALETIAE*
(DIPTERA: TACHINIDAE)

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ABSTRACT—*Lespesia stonei*, n. sp., previously confused with the common *L. aletiae*, is described as a parasite of notodontid genera *Symmerista* and *Heterocampa*. The recognition characters for *L. laniiferae* are revised and a partially revised key to *Lespesia* is presented.

The genus *Lespesia* Robineau-Desvoidy (formerly *Achaetoneura*) is one of the commonest genera of North American Tachinidae. Twenty-one Nearctic species are recognized in the latest revision (Beneway 1963), and adults of several of the species, including *L. aletiae* (Riley), are commonly reared from numerous lepidopterous hosts. *Lespesia aletiae* has been one of the most distinctive species, both terga 1 + 2 and 3 of the abdomen lacking median marginal bristles, a character shared only with *L. rileyi* (Williston) in this genus. Recently, I realized that two species, at least the males, have been confused under the name *aletiae*. A survey of available material indicates that true *aletiae* is so much more common that misidentifications are probably relatively few. I am indebted to Dr. John F. Anderson of the Connecticut Agricultural Experiment Station at New Haven for securing a good series of specimens from the red-humped oakworm, *Symmerista canicosta* Franclemont, which made possible the recognition and definition of the new species near *aletiae*.

Males of the new species keyed directly and easily to *L. aletiae* because of the absence of median marginal bristles on terga 1 + 2 and 3, but the females had median marginals on tergum 3 and hence did not agree with females of *aletiae*. The male genitalia proved to be distinct from those of *aletiae*, and other less obvious differences were also found. Extensive comparisons were carried out with other species, especially to be sure that the female had not been described elsewhere, and it was finally concluded that the species was undescribed. Males alone would undoubtedly have been misidentified in the past as *aletiae*, a species regarded as so distinct on the basis of abdominal chaetotaxy that the male genitalia were not examined. Unassociated females, if identified beyond genus—a more or less uncertain matter in *Lespesia*—might have been called *cuculliae* or *schizurae*. The published descriptions of *aletiae* fit the present species so well that a full description seems unnecessary.

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The three known hosts of the new species are all Notodontidae, but the sample is small and the host relationship is not necessarily significant.

I take pleasure in dedicating this species to Alan Stone, my good friend for forty years and a respected colleague for nearly three decades, in recognition of his contributions to dipterology and to the Entomological Society of Washington.

Lespesia stonei Sabrosky, new species

A relatively large species (10 mm), the general color, proportions, and chaetotaxy as described for *aletiae* by Beneway (1963: 636) and Sabrosky and Reardon (1976: 57) unless otherwise noted; abdomen predominantly black, dark reddish on sides but broadly black on dorsum; tergum 5 of abdomen with longer and stronger bristles and bristlelike hairs than in *aletiae*, although this appearance is probably a function of the larger size, at least in part; scutellum with 4 pairs of lateral bristles, or in other words, with 2 intermediate laterals on each side between subapical and basal bristles; mid tibia with a short and weak bristle, or occasionally 2, just proximad of the usual long and strong median anterodorsal bristle; claws and pulvilli longer than distal tarsomere.

Males: Frons similar to that of *aletiae*, narrow compared with most species in the genus, viewed from above the width at vertex little over $\frac{1}{2}$ the width of an eye and less than $\frac{1}{4}$ the head width; as in *aletiae*, no median marginal bristles on both terga 1 + 2 and 3; hind tibia densely and evenly ciliate, without a longer bristle in the row (exception in one specimen); male genitalia distinctly different from those of *aletiae*, cerci long, slender, and almost straight, surstyli moderately narrow and tapering to narrowly rounded apex (fig. 1).

Females: No median marginal bristles on abdominal tergum 1 + 2, but a strong pair on tergum 3, unlike *aletiae*; hind tibia as in *aletiae*, with long median bristle in anterodorsal row of cilia.

Holotype male, allotype, and 22 paratypes (9♂♂, 13♀♀), Sterling, Conn., various dates 1973-74 (R. or B. Moore, or M. Fergione), reared from *Symmerista canicosta*. Other paratypes: 1♂, 2♀♀, Voluntown, Conn., Sept. 18, Oct. 2 and 8, 1974 (M. Fergione), from *S. canicosta*; 1♂, Frederick, Md., May 10, 1974 (C. L. Staines, Jr.), reared from *Heterocampa manteo* (Doubleday); 1♂, Gull Lake Biological Station, Kalamazoo Co., Mich., June 23, 1959 (R. L. Fischer); 4♂♂, 1♀, Lewis Co., N.Y., May-June 1935 (D. C. Allen), reared from *Symmerista leucitys* Franclemont; 1♂, Jackson, S.C., May 24, 1959, trap light (W. Tarpley). Holotype, allotype, and paratypes in the U.S. National Museum, Type No. 74016; paratypes in the collection of the Connecticut Agricultural Experiment Station and the New York State University College of Forestry at Syracuse University.

In *Lespesia*, males of *L. stonei* share with only *aletiae* and *rileyi* the distinctive character of lacking median marginal bristles on the 3rd abdominal tergum (apparent 2nd). *Lespesia rileyi* is much different from the other species, however, having predominantly reddish

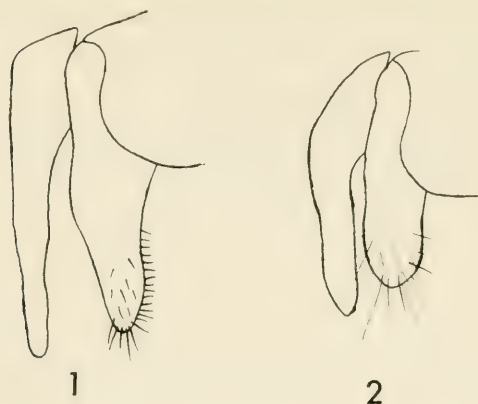


Fig. 1, 2, male terminalia. 1, *Lespesia stonei*. 2, *L. aletiae*.

and chiefly shining abdomen, wide male frons, and short claws and pulvilli. *Lespesia stonei* differs from *aletiae* principally in lacking a long median bristle in the ciliate anterodorsal row on the hind tibia, and in the male genitalia (fig. 1), as well as in larger size (10 vs. 8 mm). Like *aletiae*, it has 4 pairs of lateral scutellars and long claws and pulvilli. Both *aletiae* and *stonei* have a relatively narrow frons, at the vertex obviously narrower than the width of an eye and approximately one-fourth the head width, and in this respect they resemble only *schizurae*, *melalophae*, *pholi*, and *testacea* in the large genus *Lespesia*.

Females of *Lespesia* are less distinctive and correspondingly more difficult to identify with assurance unless they are associated with males. The characters of predominantly black abdomen, 4 pairs of lateral scutellars, and median marginal bristles absent on tergum 1 + 2 (apparent 1st) but present on tergum 3 associate *L. stonei* only with *cuculliae*, *pholi*, *laniiferae*, and *schizurae*. *Lespesia laniiferae* (Webber), of which the holotype and allotype are before me, is a much smaller species than *stonei*, and the first two antennal segments are bright red. Moreover, it has been erroneously placed in Beneway's key; it is actually a species with predominantly reddish abdomen, with only a narrow, almost linear median black stripe. In *L. pholi* (Webber), the thorax is yellowish gray and the parafrontals are decidedly yellow. Females of *L. schizurae* (Townsend) are very close to those of *stonei* and the two will be difficult to distinguish unless associated with males. In *schizurae* the anterodorsal cilia on the hind tibia are shorter and slightly wider apart, but the difference is one of slight degree and my sample is rather small. *Lespesia cuculliae* (Webber), known only from females, is a small species with short 3rd antennal segment, barely over twice the length of the 2nd

segment. One other species, *L. fasciagaster* Beneway, is also known only from the female sex, but that is a much different species: the frons and parafacials are unusually broad and the antennae are largely reddish, and it is probably near *L. archippivora* (Riley).

The position of the new species and the revised position of *L. laniiferae* can best be shown by a partial key to the males, which are more distinctive than females. Males are unknown for two species, *L. cuculliae* (Webber) and *L. fasciagaster* Beneway. Females of the latter have unusually broad frons, and it seems probable that it is a species near *archippivora* (see couplet 5).

Key to males

1. Abdomen predominantly reddish except for narrow median black stripe dorsally 2
- Abdomen predominantly black, red only on sides 5
2. Claws and pulvilli longer than distal tarsomere; frons obviously narrower than width of an eye and about $\frac{1}{4}$ width of head *L. testacca* (Webber)
- Claws and pulvilli shorter than distal tarsomere; frons relatively broad, subequal to or greater than width of an eye and nearly $\frac{1}{3}$ width of head 3
3. Abdomen dull, almost entirely gray to yellowish-gray tomentose *L. laniiferae* (Webber)
- Abdomen predominantly shining, tomentose only narrowly at bases of terga 3 to 5 4
4. No median marginal bristles on terga 1 + 2 and 3; hind tibia without a long median bristle anterodorsally in the row of cilia *L. rileyi* (Williston)
- Median marginal bristles present on terga 1 + 2 and 3, those on 3 strong; hind tibia with long bristle midway in the anterodorsal row of cilia *L. ferruginea* (Reinhard)
5. Claws and pulvilli longer than distal tarsomere 6
- Claws and pulvilli shorter than distal tarsomere *L. archippivora* (Riley), *L. parva* Beneway, *L. texana* (Webber), *L. westonia* (Webber)
6. No median marginal bristles on tergum 3 7
- Median marginals present on tergum 3 8
7. Hind tibia with a long bristle anterodorsally in row of cilia; cerci and surstyli short (fig. 2) *L. aletiae* (Riley)
- Hind tibia closely and evenly ciliate anterodorsally, without a longer bristle in the row; cerci elongate and slender, the surstyli longer and narrower than in *aletiae* (fig. 1) *L. stonei* n. sp.
8. (The remaining species of *Lespesia*).

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- Sabrosky, C. W., and Reardon, R. C. 1976. Tachinid parasites of the gypsy moth, *Lymantria dispar*, with keys to adults and puparia. Misc. Publ. Entomol. Soc. Am. 10(2): 1-126, 73 figs.

REVISIONARY NOTES ON NORTH AMERICAN TEPHRITIDAE (DIPTERA), WITH KEYS AND DESCRIPTIONS OF NEW SPECIES

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ABSTRACT—*Orellia undosa* (Coq.) is transferred to *Chaetostomella* Hendel; San Diego, CA specimens of *Cryptotreta pallida* (Cole) of Blanc and Foote are redescribed as *C. cislimitensis* Steyskal, n.sp.; *Rhagoletoides* Foote is made a new synonym of *Oedicarena* Loew, and a new key to the species of the latter is presented; *Eurosta floridensis* Foote, n.sp., is described from Jasper and Orlando, FL, and a key to *Eurosta* spp. is presented for the first time; *Valentibulla steyskali* Foote, n.sp. is proposed for the concept assigned to *Valentibulla munda* (Coq.) by Foote and Blanc 1959, and a new key to the species of *Valentibulla* is provided.

This paper includes descriptions of several new species belonging to various New World genera of Tephritidae and presents necessary changes in the nomenclature of several taxa to bring the use of several names into conformity with the Manual of North American Diptera soon to be published by Agriculture Canada. We also present keys to the species of some genera for which published revisions have never been available, and we have updated others to make them more useful in the light of recent taxonomic developments.

The research reported herein is in large part that of the senior author; the junior author reviewed, concurred in, and edited the manuscript, and provided the description of one new species in a very minor way. Both authors are deeply pleased to honor Alan Stone with this contribution to the published record of a family to which he made important taxonomic contributions.

Genus *Chaetostomella* Hendel

Chaetostomella Hendel, 1927: 21, 124. Type-species, *Trypeta onotrophes* Loew, 1846, by original designation.

In the American fauna, this genus finds its place with a small group of non-dacine and non-myopitine genera characterized as follows: dorsocentral bristles anterior to halfway between supra-alar and acrostichal bristles; scutellum not distinctly swollen nor polished; posterior upper fronto-orbital bristles convergent. This group includes also *Orellia* Robineau-Desvoidy and *Neaspilota* Osten Sacken, from both of which it may be easily distinguished by a few well-developed setae on the anterior oral margin that are larger than adjacent setae. Only the following species is known from North America.

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Chaetostomella undosa (Coquillett), **new combination**

Trypeta undosa Coquillett, 1899: 262.

Orellia undosa (Coquillett) McFadden and Foote, 1961: 256.

Chaetostomella undosa is very similar in general external characters to the type of its genus, *C. onotrophes* (Loew). The wing pattern and venation and the characters of color, color pattern, chaetotaxy, and vestiture are virtually identical in the 2 species, except in the development of 6 black spots on the last preabdominal tergum. These spots in both species consist in a median anterior pair and a pair in the anterior and posterior ends of each lateral margin. The posterolateral spots may sometimes be absent. Only in *C. onotrophes* have we seen these spots fused into a pair of roughly L-shaped marks. The only reliable external character we have found is the height of the cheek. In *C. onotrophes* we have found the cheek to vary between 0.17 and 0.26 of the eye-height (average, 0.22), whereas in *C. undosa* the proportion is 0.31 to 0.43 (average, 0.38). Lack of sufficient specimens of the female sex of *C. undosa* (only holotype is available) has induced us to defer examination of the postabdomen.

Cryptotreta pallida (Cole)

Eurosta pallida Cole, 1923: 472.

Cryptotreta pallida (Cole) Blanc and Foote, 1961: 82.

Eurosta pallida Cole was described from a single male specimen captured at San Francisquito Bay, Baja California, Mexico, about 640 km southeast of San Diego, California, on the Gulf side of the peninsula of Baja California. The species was recorded from San Ysidro, San Diego County, California by Blanc and Foote (1961) at the time they designated it as the type of their new genus *Cryptotreta*. Since that time we have received additional material from the vicinity of San Diego. This material is consistently different from the type of *C. pallida*, which one of us (Steyskal) examined in 1968. The San Diego specimens are therefore described below as a new species.

Cryptotreta cislinitensis Steyskal, new species
figs. 1-6

Very similar to *Cryptotreta pallida* (Cole), except as follows. Group of hyaline spots forming contrasting mottled area about a squarish spot in middle of discal cell, as in figure ascribed to *C. pallida* by Blanc and Foote (1961, fig. 1). In *C. pallida*, such an area is hardly contrasted with adjacent areas and entire wing pattern is much less contrasty than indicated in Cole's drawing (1923, fig. 10). Dark band of wing extending from pterostigma to anal lobe includes about twice as many small pale spots in the type of *C. pallida* as are shown in Cole's figure or in *C. cislinitensis*. Last 2 abdominal terga blackish, with narrow mesal yellow

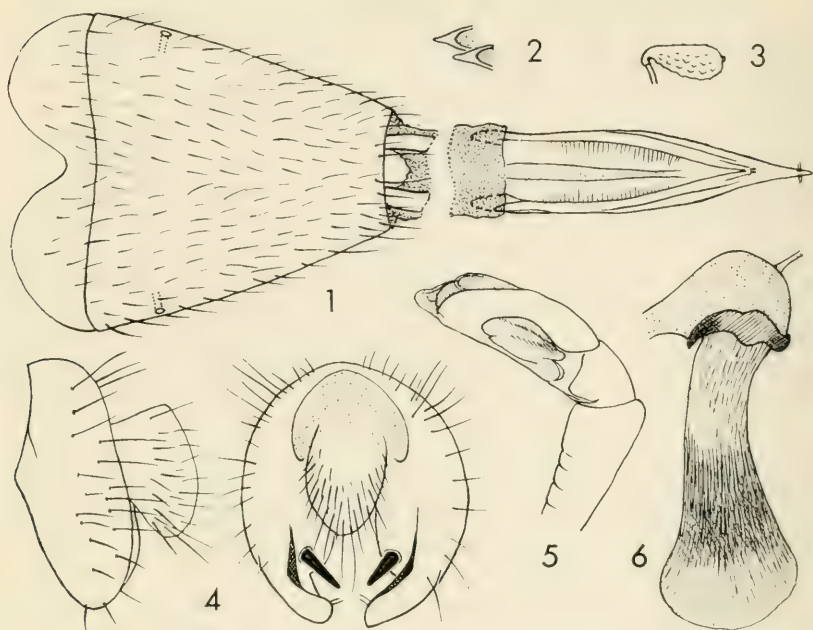


Fig. 1-6, *Cryptotreta cislimitensis*. 1, ovipositor sheath and ovipositor, dorsal view. 2, largest spicules of rasper. 3, spermatheca. 4, profile and posterior views of male postabdomen. 5, tip of aedeagus. 6, sperm-pump.

stripe (in *C. pallida* uniformly brown). Scutellum of both species yellowish, in *C. cislimitensis* with conspicuous but diffuse brown area at base of each lateral seta. Postabdomen of female as in figs. 1-3; of male as in figs. 4-6. Ovipositor sheath blackish above, with diffuse, roundish, orange central area and largely orange with black ends ventrally.

Holotype, male, allotype, and 8 paratypes (4 each of each sex), Chula Vista, San Diego County, California, April 3, 1968 (E. D. Alpert); one female paratype, San Diego, California, April 9, 1968, black light trap; all in U.S. National Museum, type no. 74004.

The species name is an adjective derived from the Latin noun *limes* 'limit, border' and meaning 'pertaining to this side of the border.'

Eurosta floridensis Foote, new species
fig. 7-10, 17

Length of wing 6.75-7.4 mm. General appearance very similar to other species in the genus, the small appressed setae covering most of body and legs very light golden or colorless under artificial light. Head and body without distinctive color pattern. No discernible differences in sexes except for postabdominal features. Differences from the described species of *Eurosta* reside chiefly in color pattern of wing. *Eurosta floridensis*, as shown in the accompanying key is ap-

parently most closely related to *E. fenestrata* Snow, a species found in central and northern North America, east to Oklahoma and Ontario. Numerous, rather distinct, rounded golden spots scattered over disk, lighter in color than disk but not hyaline except at wing margins. Apical hyaline arc very narrow, restricted almost entirely to apex of 2nd posterior cell, usually a small isolated spot immediately anterior to it in apex of 1st posterior cell. Postpterostigmatal marking with "comma" distinct. A small but distinct round hyaline spot present in 1st posterior cell immediately distad of apex of costal cell. Light area in posterior proximal area of wing disk rather solidly hyaline in 3rd posterior cell, especially anteriorly where a distinct, sometimes discrete, hyaline spot is present, usually with irregular margins as if the spot were a result of the complete coalescing of reticulation; hyaline area in 3rd posterior cell clearly reticulate but more hyaline than pigmented.

Female. Ratio of length of dorsum to greatest height of ovipositor sheath 1:1.6; ratio of length of ovipositor tip to entire length of ovipositor 1:3.4 (figs. 7, 8); largest spicules of rasper (fig. 9) somewhat heavier than in *E. fenestrata* (Snow) (fig. 14).

Male. Postabdomen as in fig. 10; apical margin of epandrium emarginate in profile; tip of aedeagus as in fig. 17.

Holotype female (USNM Type No. 74005), Jasper, Fla., 11-18 Nov., 1930, Allotype, Dunellon, Fla., Dec. 16, 1930, D. J. Nicholson. Paratypes as follows: 1♀, same data as holotype; 1♂, 1♀, same data as holotype but Dec. 5 and 19, respectively; 1♀, 6 mi W. Jasper, Fla., Oct. 28, 1930; 1♀, 1♂, Orlando, Fla., Dec. 19-29, 1930 and Jan. 21-28, 1931, respectively; 1♀, Paradise, Fla., Dec. 5, 1930. Holotype, allotype, and all paratypes were bred from *Solidago* sp. roots by D. J. Nicholson. An additional male represented in the study series was reared from *Solidago fistulosa* ¼ mi east of Orlando on Dec. 29, 1930 by D. J. Nicholson.

Hosts of *Eurosta elsa* and *E. comma*

In the paragraph preceding the original description of *Eurosta elsa* Daecke (1910, p. 342), the author states, "The flies reared from *Solidago juncea* proved to be the true form of *Eurosta comma* Wied. (see plate), but those from *Solidago rugosa* taken at Richmond Hill, L.I., differed uniformly from this species and proved to be a form new to science." However, on page 343 he states, "The figure of upper left-hand corner of Plate X shows the galls of *Eurosta comma* on the root of *Solidago rugosa* Mill. The rest of the plate pictures *Solidago juncea* with the galls of *Eurosta elsa*." In the paragraph preceding the first quotation (p. 342), Daecke also states, "... where I also collected *E. comma* in September. After a little search I located the galls and was surprised to find them on *Solidago rugosa* Mill., while those from Richmond Hill, L.I., were taken on *Solidago juncea* Ait."

Phillips (1923, p. 144, but not 1946, p. 114) ascribes to *Eurosta elsa* the host *Solidago rugosa* and to *E. comma* the host *S. juncea*, as

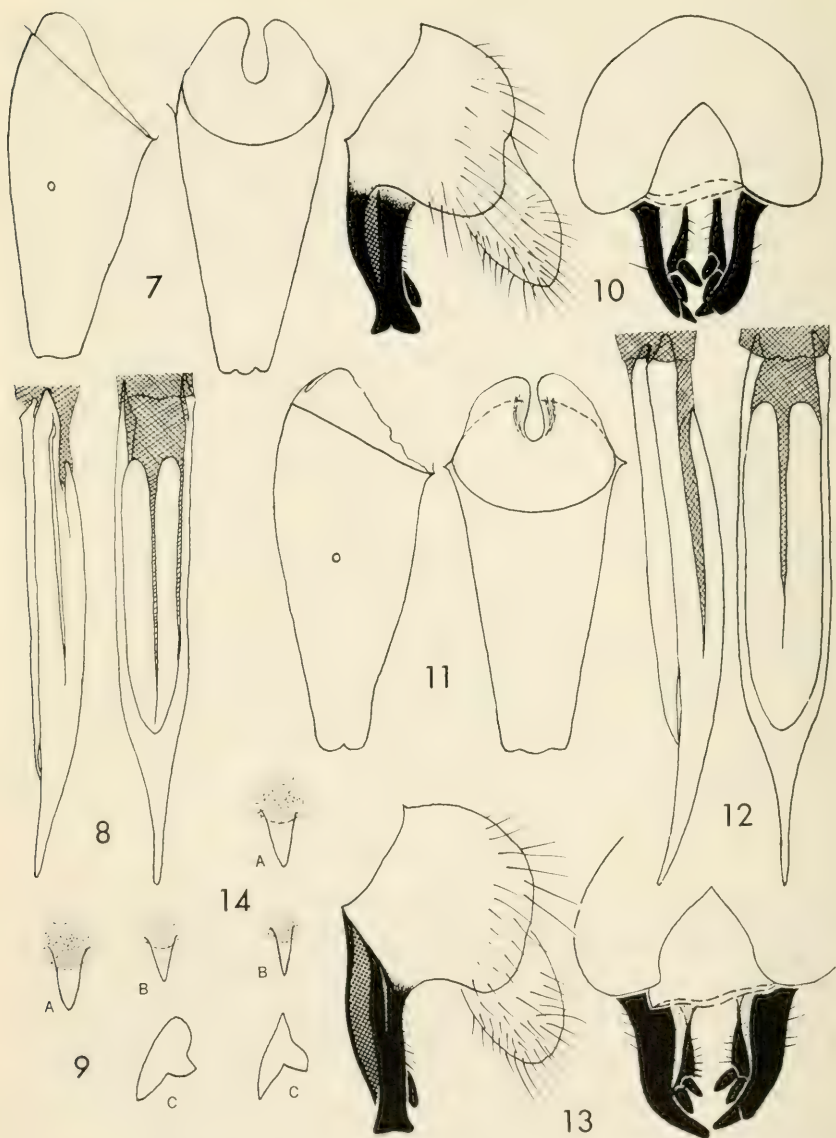


Fig. 7-14, *Eurosta* species. 7, *Eurosta floridensis*, dorsal and lateral views of ovipositor sheath. 8, *ibid.*, dorsal and lateral views of ovipositor. 9, *ibid.*, largest spicules of rasper (a, ventral; b, dorsal; c, lateral). 10, *ibid.*, profile and posterior views of male postabdomen. 11, *Eurosta fenestrata*, White Mts., New Mexico, dorsal and lateral views of ovipositor. 12, *ibid.*, dorsal and lateral views of ovipositor. 13, *ibid.*, profile and posterior views of male postabdomen. 14, *ibid.*, largest spicules of rasper (a, ventral; b, dorsal; c, lateral).

stated in the first quotation above. Benjamin (1934, p. 28) also cites Daecke as stating that *S. juncea* is the host of *E. comma*. Novak et al. (1967) cite *S. juncea* as a new host record for *E. elsa*.

Daecke's statement in the first quotation is evidently a lapsus reversing the host names. The 2 other statements by Daecke, as well as the labels on 2 of the 5 type specimens of *E. elsa* in U.S. National Museum "reared from *Solid. juncea*" on "Type (1)" and "bred from *Sol. juncea*" on "Type (2)", as well as the rearing by Novak et al., apparently represent the true host of *E. elsa*. The female "Type (2)" is hereby selected as lectotype.

Key To The North American Species Of The Genus *Eurosta*

- 1(8) Apex of wing with narrow crescentic hyaline mark, sometimes broken into 3 small spots by darkening about ends of 3rd and 4th veins *Comma* group
- 2(3) Wing with reduced postpterostigmatal spot not divided by median bar, without anal pale mark *E. elsa* Daecke
- 3(2) Postpterostigmatal spot equilateral-triangular, extending into submarginal cell and divided by median transversa bar or "comma."
- 4(5) Pale mark at end of anal vein little developed, not extending over $\frac{1}{2}$ way across 3rd posterior cell; ovipositor sheath short (fig. 15); male postabdomen (fig. 16), lower margin of epandrium square and straight, tips of claspers very sharp *E. comma* (Wied.)
- 5(4) Wing with conspicuous pale mark extending inward from end of anal vein; ovipositor sheath long (figs. 7, 11); male postabdomen (figs. 10, 14) with profile of lower margin of epandrium concave, tips of claspers not as sharp.
- 6(7) Anal pale spot of wing with discrete margins; ovipositor (fig. 12) and claspers (fig. 13) longer *E. fenestrata* Snow
- 7(6) Anal pale spot reticulate, at least around wing margin; ovipositor (fig. 8) and claspers (fig. 10) shorter *E. floridensis* Foote
- 8(1) Hyaline apex of wing broad, with several spots extending well inward from wing tip.
- 9(10) Wing with 3 triangular pale areas broadly based on wing margin. 1 postpterostigmatal which is divided by median bar and 2 in 2nd and 3rd posterior cells respectively, usually non-reticulate; postpterostigmatal mark and the one in 2nd posterior cell sometimes connected *E. solidaginis* (Fitch)
 - a. Postpterostigmatal mark and that in 2nd posterior cell fully connected, forming an uninterrupted hyaline band extending transversely across wing from anterior to posterior margins var. *fascipennis* Curran
 - b. Postpterostigmatal mark distinctly separated from that in 2nd posterior cell var. *subfasciata* Curran
- 10(9) Wing marked otherwise, postpterostigmatal hyaline triangle not extending into first posterior cell, posterior hyaline triangles more or less reticulate, broken into spots, or reduced.

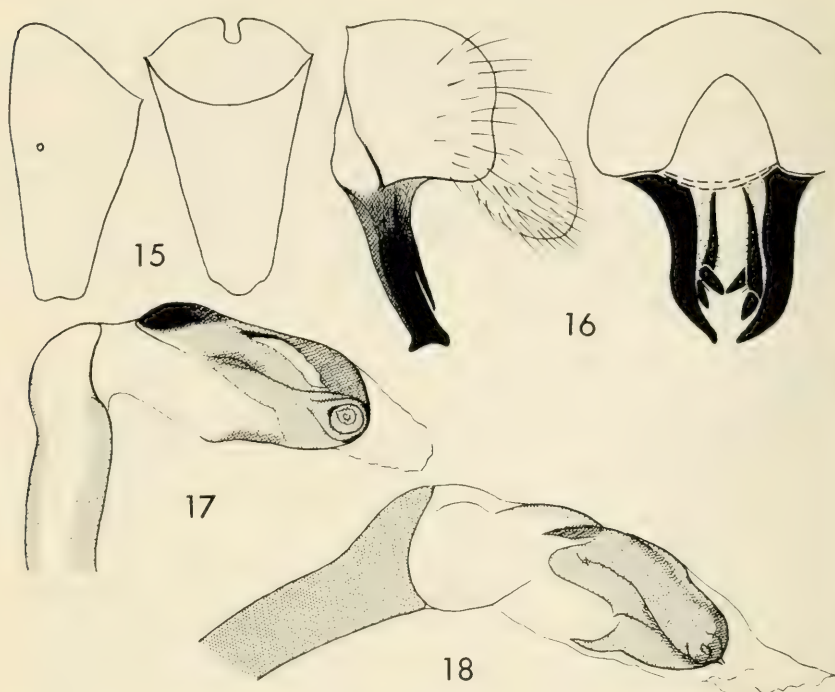


Fig. 15-18, *Eurosta* species. 15, *Eurosta comma*, College Park, Maryland, dorsal and lateral views of ovipositor sheath. 16, *ibid.*, profile and posterior views of male postabdomen. 17, *Eurosta floridensis*, tip of aedeagus. 18, *Eurosta fenestrata*, tip of aedeagus.

- 11(12) Postpterostigmatal spot closely followed around tip of wing into 2nd posterior cell by a series of approximately equal spots, bulla of 1st posterior cell especially large and deep *E. latifrons* Loew
- 12(11) Spots as described above not present.
- 13(14) Posterior hyaline areas reduced, that in 3rd posterior cell not triangular, attaining posterior margin narrowly or not at all; apex of wing with hyaline spots widely separated *E. lateralis* (Wied.)
- 14(13) Posterior hyaline areas of wing well developed as reticulated triangular areas or triangles of closely grouped spots.
- 15(16) 4th posterior cell with about 15 hyaline spots *E. reticulata* Snow
- 16(15) 4th posterior cell with only about 6 hyaline spots *E. conspurcata* Doane

Genus *Oedicarena* Loew

Oedicarena Loew, 1873: 247. Type-species *O. tetanops* Loew by original designation; Foote 1960b: 114.

Rhagoletoides Foote, 1960a: 145. Type-species *Spilographa latifrons* Wulp, by original designation. *New Synonym.*

When the genus *Rhagoletoides* was proposed in June, 1960, it was compared with *Rhagoletis*, *Zonosemata*, *Trypeta*, *Euleia*, and *Chaetostoma*, but in December, 1960 (Foote, 1960b p. 114), it was stated, "*Oedicarena* very closely resembles *Rhagoletoides* Foote (1960) in having a prominent facial carina, golden mesonotal pollen, and a suggestion of paired brown mesonotal spots, but differs from that genus in lacking strong femoral spines and (having) a narrow gena." In reexamining the pertinent species during construction of the key to the Tephritidae for the forthcoming Manual of North American Diptera, we found that the difference in genal (cheek) height is indeed appreciable, but the strong femoral spines are only a little heavier in *latifrons* than in *tetanops*. We therefore now consider these differences as insufficient for generic separation, while the many similarities indicate a very close phylogenetic relationship of all the species in the following key.

Key To Species Of *Oedicarena* Loew

- 1(2) Cheek 0.26–0.32 of eye-height; parafacials at narrowest point 0.66 of greatest width of 3rd antennal segment; apical spot of wing single and widely separated from preapical transverse band or row of spots; apex of scutellum usually with blackish spot.
O. latifrons (Wulp), n. comb.
- 2(1) Cheek 0.5–0.63 of eye-height; parafacials at narrowest point 0.75 of greatest width of 3rd antennal segment; apical spot of wing connected with preapical band or row of spots or wing with 2 apical spots, one each at tips of veins R_5 and M_1 ; apex of scutellum concolorous with base.
- 3(4) Apical spot forming part of costal band meeting transverse band.....
O. persuasa (Osten Sacken)
- 4(3) Apical spots 2, one each at ends of veins R_5 and M_1
O. tetanops Loew

Since Foote (1960a) cited records for *O. latifrons*, an additional United States specimen has come to hand: ♂, Pawnee National Grassland, Weld County, Colorado, 9 August 1970 (R. T. Bell), in U.S. National Museum.

Valentibulla steyskali Foote, new species

Valentibulla munda (Coq.) Foote and Blanc, 1959: 152, misidentification

The holotype of *Euaresta munda* Coquillett (1899: 265) in the U.S. National Museum is represented at this time by only a small fragment of the thorax glued to a pin; part of the ventral portion of the thorax with leg fragments is also present and glued upside down on the top label of the same pin, but all other body parts are missing.

However, enough of the holotype is present to verify that part of Coquillett's original description: "Thorax and scutellum opaque, densely gray pruinose."

The senior author correctly points out that the insect described as *munda* by Foote and Blanc (1959) is not that species due to its shining dorsal thoracic and scutellar surfaces and other features differing from Coquillett's original description. Consequently, I (Foote) here name the species incorrectly identified and described as *Valentibulla munda* (Coq.) by myself and Blanc in 1959 as *Valentibulla steyskali* Foote, n.sp. The holotype is a female (USNM Type No. 74006) from Lucky Park Reservoir, 18 mi E. Boise, Idaho, reared from *Chrysothamnus nauseosus* April 24, 1961, by R. B. Ferguson.

The morphological characters in the key presented here will serve to distinguish the true *munda* of Coquillett.

Key To The Species Of The Genus *Valentibulla* Foote And Blanc

- 1(2) Dorsum of mesoscutum (at least in posterior $\frac{2}{3}$) polished black, bearing only macrochaetae and short, thick setae; apical wing spot $\frac{1}{2}$ length of cell R_5 , anterior preapical hyaline spot in cell R_5 (against vein R_5) larger than posterior spot (cf. fig. 6, Foote and Blanc, 1959) *V. steyskali*, n.sp.
- 2(1) Dorsum of thorax tomentose, dull gray; apical wing spot shorter, about $\frac{1}{4}$ length of cell R_5 .
- 3(4) Spot in cell R_3 posterior to middle one of 3 in cell R_1 lacking, discal cell without hyaline spot, preapical hyaline spots in cell R_5 lacking or very small *V. mundula* Coquillett
- 4(3) Hyaline spot present in cell R_3 posterior to middle one of 3 in cell R_1 ; apical parts of discal cell and cell R each with well developed hyaline spot; preapical hyaline spots in cell R_5 usually present on veins R_5 and M , the former usually smaller and sometimes lacking.
- 5(6) Hyaline incisions in 2nd posterior cell (2nd M_2) narrower than blackish intervening areas; hyaline spot posterior to apical spot in cell R_1 usually present and apicad of that spot *V. thurmanae* Foote
- 6(5) Hyaline incisions in second posterior cell broader than intervening brown or blackish areas; hyaline spot posterior to apical spot in cell R_1 absent or contiguous to that spot.
- 7(8) Legs, especially middle and hind ones, with femora and tibiae largely blackish *V. munda* Coquillett
- Legs usually wholly yellowish *V. californica* Coquillett

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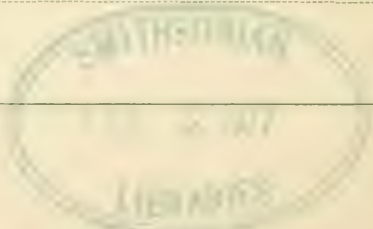
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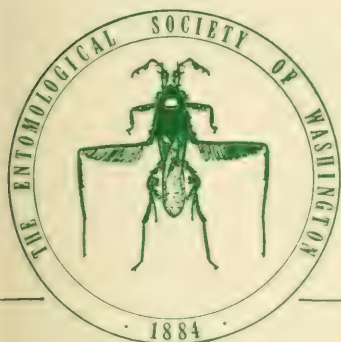
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No. 2

STUDIES ON THE GENUS *APHODIUS* OF THE UNITED STATES
AND CANADA (COLEOPTERA: SCARABAEIDAE): V. AN
EVALUATION OF HORN'S GROUP F

ROBERT D. GORDON

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ABSTRACT—Horn's Group F of the genus *Aphodius* is redefined and restricted to include three species, *Aphodius alternatus* Horn, *A. subaeneus* LeConte, and *A. consociatus* Horn. Four species names are placed in synonymy, and three species are transferred out of Group F. Pertinent morphological details are illustrated and distribution maps are provided.

This is the fifth paper in a series dealing with North American *Aphodius*. See Gordon (1973) for an explanation of the purposes of this series.

Members of group F are small, usually yellow and black species distinguished from other groups of *Aphodius* by the following combination of characters: Apex of hind tibia with short, equal spines; head smooth, not tuberculate; clypeus feebly emarginate apically, not dentate. Species of this group are not uncommon in collections, and the need to identify them arises frequently. It has not previously been possible to do this satisfactorily, so I have studied the group in detail, and the results of the study are presented herein.

Horn (1887) established Group F and placed the following four species in it: *obtusus* LeConte, *consociatus* Horn, *subaeneus* LeConte, and *alternatus* Horn. Fall (1907) described *rotundiceps* and stated that it was closest to members of Group F, so the Leng catalogue (1920) included it in Group F. Schmidt (1913 and 1922) put *consociatus*, *subaeneus* and *alternatus* in the subgenus *Volinus* Mulsant, and *obtusus* in the subgenus *Bodilus* Mulsant. In 1938, Robinson described *utahensis* and indicated it was close to *obtusus* and so a member of Group F. In 1940, Robinson described *inermis*, compared it to *alternatus* and thus indicated that *inermis* belonged in Group F.

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Hatch (1971) described *moclipsi* and *gentneri*, placed the former in the subgenus *Calamosternus* Motschulsky and stated that *gentneri* did not belong in any defined subgenus; but I have found from the types that both are junior synonyms of previously described species in Group F. Gordon (1973) described *perpolitus* to make a total of ten names that have been assigned to Group F from 1887 to the present.

Of the ten names now in Group F, four are herein reduced to junior synonyms of previously described species. *Aphodius obtusus* and *utahensis* are not closely related to *alternatus*, etc., and I tentatively assign them to Group I, series c, near *consentaneus* LeConte. *Aphodius rotundiceps* is completely unlike any other Western Hemisphere species and cannot be assigned to any established group. With these changes, Group F is composed of three closely related species and is considered monophyletic. As previously indicated (Gordon, 1973), I do not use Schmidt's subgeneric assignments because the subgenera are rarely monophyletic and do not readily accommodate North American species.

The species of Group F occur in the western half of the United States and contiguous areas of southern Canada with *alternatus* extending eastward as far as Michigan. Both *consociatus* and *subaeneus* are restricted to the West Coast, *consociatus* in southern California and *subaeneus* extending from southern California to southern British Columbia. They are allopatric and similar, hence probably are sister species.

Species of Group F are not dung feeders and are not associated with rodents but are saprophytic on detritus in the upper soil layer. Hatch (1971) recorded "*consociatus*" (*alternatus*) reared from golf turf at Longbeach, Washington. When not taken flying, specimens are usually collected near margins of ponds and streams, apparently preferring the damp soil in those locations. I have collected *alternatus* in North Dakota while collecting water beetles in prairie sloughs and lakes, the beetles were either up on the bordering vegetation or crawling on the ground. *Aphodius alternatus* is capable of massive flight activity as observed by J. Schuh at Kirk, Klamath Co., Oregon, on October 23, 1966. I observed the same flight behavior in central North Dakota in September 1965.

I am indebted to the following individuals and institutions for the loan of types and other specimens: David Carlson, Department of Entomology, Oregon State University, Corvallis; John Carr, Calgary, Alberta; David Kavanaugh, California Academy of Sciences, San Francisco; John Lawrence, Museum of Comparative Zoology, Harvard University; Sievert Rohwer, Thomas Burke Museum, University of Washington, Seattle; Joe Schuh, Klamath Falls, Oregon.

GROUP F

Head mostly black, at least medially; convex, without frontal tubercles; anterior clypeal margin not dentate, anterolateral angle broadly arcuate. Pronotum mostly black, sexually dimorphic. Male front tibial spur robust, bent downward at apex, laterally flattened (Fig. 1); both middle tibial spurs slender, apically acute, unmodified as in female. Apical fringe of hind tibia composed of moderately long spines nearly equal in length (unless worn down so that some are longer than others). Male genitalia soft, dorsoventrally compressed, somewhat inflated.

KEY TO SPECIES OF GROUP F

1. Basal border of pronotum without marginal line medially; 1st, 2nd and 4th elytral intervals dull, rough in most California specimens (Fig. 7); hind tibia with oblique carinae reduced, not well developed *subaeneus* LeConte
- Basal border of pronotum with marginal line medially; all elytral intervals usually smooth, if not, then usually all are rough; hind tibia with oblique carinae well developed 2
2. Pronotal punctures fine (Fig. 5), not larger than punctures of elytral intervals; striae punctures on elytron fine, equal to or very slightly larger than punctures on intervals; male anterior tibial spur broad, not hooked inward at apex (Fig. 1) *alternatus* Horn
- Pronotal punctures coarse (Fig. 6), much larger than punctures of elytral intervals; striae punctures on elytron coarse, each $2 \times$ as large as a puncture on interval; male anterior tibial spur slender apically, hooked inward at apex (Fig. 3) *consociatus* Horn

Aphodius subaeneus LeConte

Fig. 2, 4, 7-9, 22

Aphodius subaeneus LeConte, 1857:41; Horn, 1870-71:129; Horn, 1887:21; Hatch, 1971:454.

Aphodius gentneri Hatch, 1971:457. NEW SYNONYMY.

Aphodius perpolitus Gordon, 1973:439. NEW SYNONYMY.

Remarks: The typical form of *subaeneus* is readily recognizable because the first and third elytral intervals are smooth and polished, the second and fourth intervals are dull and rough (Fig. 7) and the elytra are yellow in large part. This form occurs in the coastal areas and Central Valley of California. The pronotal punctures are coarse, separated by one to three times a diameter (Fig. 4). Specimens from the mountainous areas of eastern California, northern Oregon and southern British Columbia have the yellow elytral areas reduced and all elytral intervals smooth and polished. Specimens from extreme northern California and southwestern Oregon present a different appearance from the other two forms in that they are entirely black dorsally, or black with an indistinct pale spot on the apical declivity of each elytron. In addition, the elytral intervals are flatter, the striae

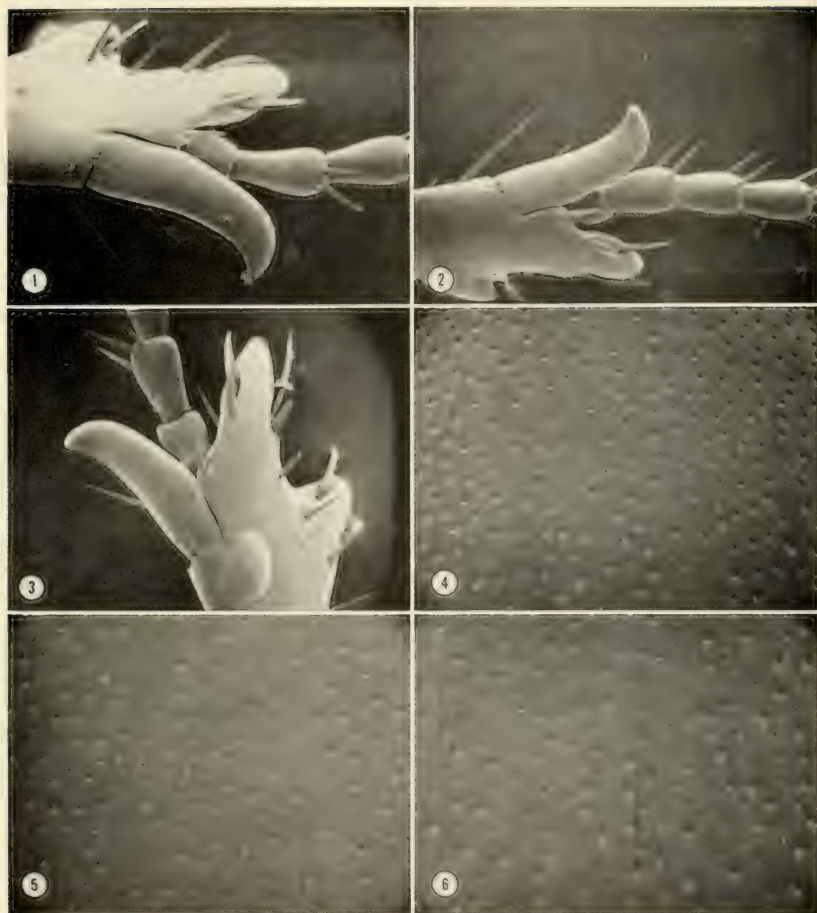


Fig. 1-6. Anterior tarsal spurs and pronotal punctures of discal pronotal area. 1, 5, *Aphodius alternatus*. 2, 4, *Aphodius subaeneus*. 3, 6, *Aphodius consociatus*.

not as deep, the marginal line on the basal border of the pronotum more widely incomplete and the pronotum more densely punctured. The male genitalia (Fig. 8, 9) and anterior tibial spurs (Fig. 2) are identical in all three forms, and I consider these forms to represent a polymorphic species. Two names have been proposed for the dark specimens from southwestern Oregon, *gentneri* Hatch and *perpolitus* Gordon, both of which I place as junior synonyms of *subaeneus*.

It is apparent from LeConte's original description that he had more than one specimen. There are presently three specimens in the LeConte Collection labeled as types; and the first of these, a

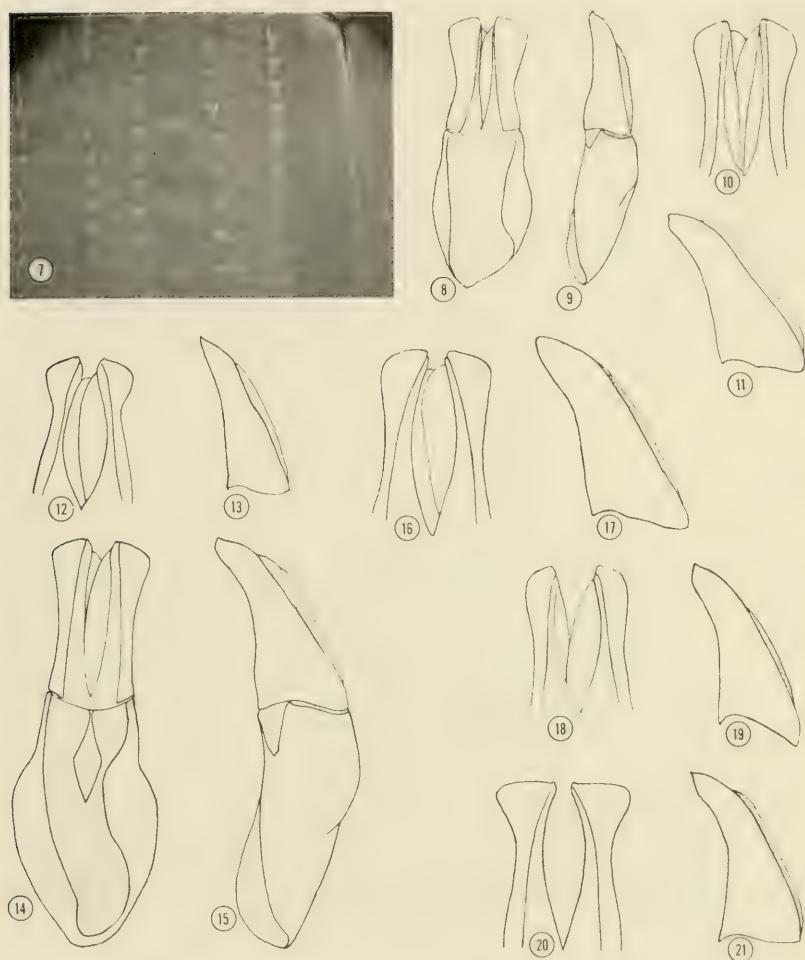


Fig. 7. First 5 elytral intervals, *Aphodius subaeneus*. Fig. 8-21. Male genitalia. 8, 9, *Aphodius subaeneus*. 10, 11, *Aphodius consociatus*. 12-21, *Aphodius alternatus*.

male, bearing the following labels, is here designated and labeled lectotype: "(gold disc)/Type 3352 (red paper)/*A. subaeneus* LeC., S. Fr." LeConte (1857:42) specifically gave San Francisco as the type-locality. The remaining two type-specimens (females) bear identical data, except the "S. Fr." is lacking, and they are designated and labeled paralectotypes. The holotype of *gentneri* in the Oregon State University collection has been examined and is a male labeled "Pinhurst, Jackson Co., Ore., V-19-60/L. G. Gentner, sweeping/Type,

Aphodius gentneri: 1967—M. Hatch." The holotype of *Perpolitus* is in the USNM type-collection (72287) labeled "Oregon, Klamath Co., Spring Creek, May 8, 1971, Joe Schuh."

Specimens examined: Total 312 (Fig. 22). BRITISH COLUMBIA: Vernon. CALIFORNIA: Alpine Co., Bloods Meadow; Ben Lomond; Cisco; Fresno; Fresno Co., Bubbs Cr. Cn., Kings River, 10,500 ft; Fresno Co., Bullfrog L., 10,600 ft; Glen Alpine; Kern Co., Breckenridge; Knights Ferry; Lake Co., Hopville; Lake Tahoe, Heather L.; Long Beach; Los Angeles; Modesto; Mokelumne Hill; Monterey Co., Carmel; Naples; Pasadena; Placer Co., Summit; Sacramento; San Francisco; San Mateo Co.; Santa Cruz; Selma; Siskiyou Co., 6 mi S. Macdoel; Tulare Co., Kaweah. OREGON: Klamath Co., Spring Creek; Klamath River below Topsy Grade; Klamath River, 12 mi S.W. Keno; Lake Co., Quartz Mt.; McMinnville; Medford; Jackson Co., Pinehurst; Tollgate.

Aphodius consociatus Horn

Fig. 3, 6, 10, 11, 23

Aphodius consociatus Horn, 1887:21; Hatch, 1971:454.

Remarks: This species and *alternatus* are very similar in external appearance and are apparently allopatric. Despite this and the fact that the male genitalia are practically indistinguishable (Fig. 10, 11), I prefer to consider them as two valid species. The key characters used for separation are apparently consistent, and in addition, *consociatus* has the clypeal margin and lateral border of the pronotum black and the elytral intervals distinctly punctured.

All specimens of *consociatus* examined have been from southern California and from coastal or near coastal localities.

Specimens from northern California and the Pacific Northwest have been identified as *consociatus* by a variety of authors. Hatch (1971) listed *consociatus* from British Columbia, Washington, Idaho, Oregon and Montana. These records must be either *subaeneus* or *alternatus*, and most of them are *alternatus*.

It is apparent from Horn's original description that he had more than one specimen. There are four specimens labeled as types presently in the Horn Collection and the first of these, a female labeled "Cal/ Type No. 3577 *Aphodius consociatus* G. II. Horn (red paper)/A. *consociatus* Horn" is designated lectotype and is so labeled. The remaining three specimens (two females, one male) bearing the following labels are designated paralectotypes and are so labeled: "Cal/ G. II. Horn A. *consociatus* Paratype 3577/Horn Coll. H10193."

Specimens examined: Total 28 (Fig. 23). CALIFORNIA: Anaheim; Long Beach; Los Angeles; Poyay; Redondo; Riverside Co., Keen Camp; San Diego; San Jacinto; San Pedro; Santa Monica; Smith's Springs, 3300 ft.

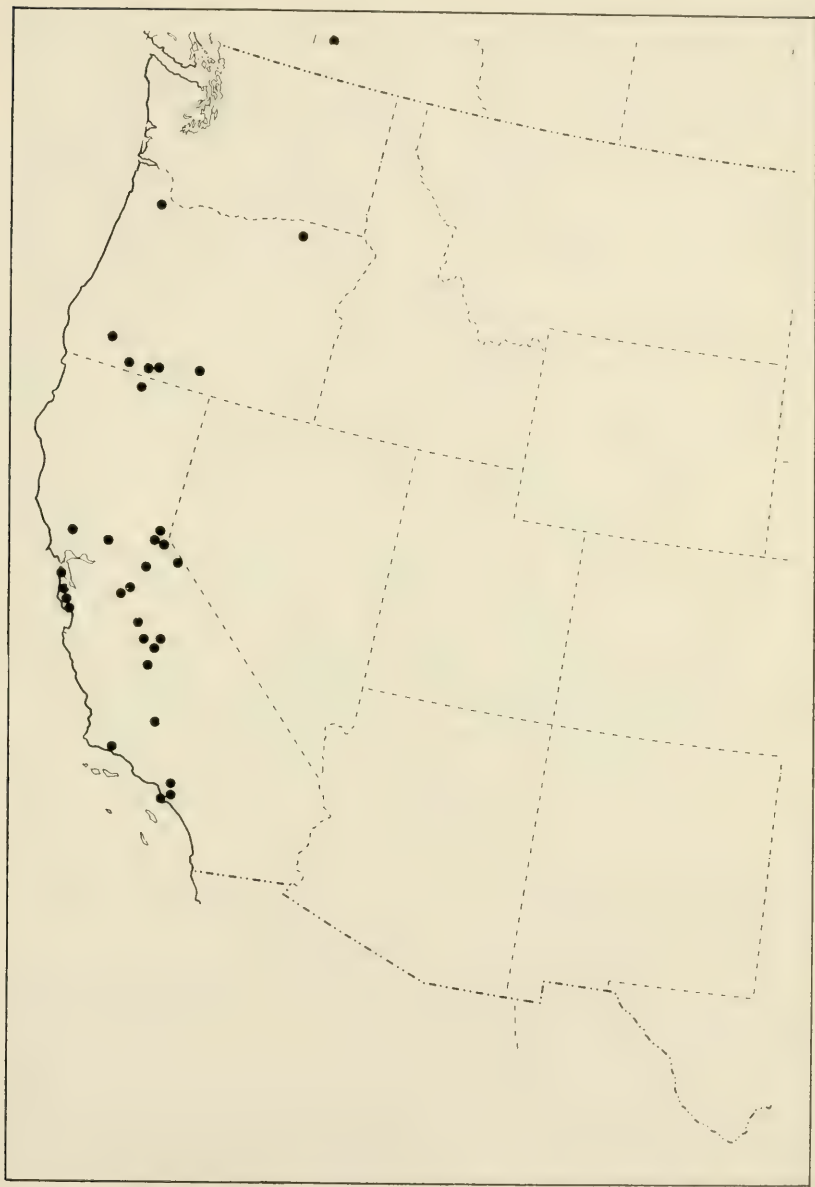


Fig. 22. Distribution of those specimens of *Aphodius subaeneus* examined.



Fig. 23. Distribution of those specimens of *Aphodius alternatus* examined.

Aphodius alternatus Horn

Fig. 1, 5, 12-21, 23

Aphodius alternatus Horn, 1870-71: 129; Horn, 1887: 22; Hatch, 1971: 454.

Aphodius inermis Robinson, 1940: 147. NEW SYNONYMY.

Aphodius moclippsi Hatch, 1971: 457. NEW SYNONYMY.

Remarks: The only species in Group F with which *alternatus* is likely to be confused is *consociatus*, but see key characters and remarks under that species.

As considered here, *alternatus* is a widespread, polymorphic species composed of populations which often are not contiguous. The typical form (form 1) occurs in California, Nevada and Utah and is characterized by having the first six elytral intervals alternately yellow and dark brown, hence the specific name. In addition, the elytral intervals are smooth, and shiny, and the pronotum is shaped as in *consociatus* and is black with no greenish tinge. The male genitalia are as in Fig. 14, 15. Form 2 is present in Oregon, Washington, Idaho and Alberta. This is the most striking of all the morphs because it has

strongly alutaceous, dull elytral intervals that are not alternately dark and pale, or rarely so. In addition, the pronotum, especially of the male, is broad, appears slightly flattened and usually has a greenish tinge. Some of the male genitalia are more robust and more strongly inflated (Fig. 16, 17) than those of the typical form, others less so (Fig. 18, 19). Form 3 occurs from Michigan and Wisconsin west to Alberta and Utah. It is smaller in average size than any of the other forms and tends to be darker in color, with entirely dark specimens not uncommon (*inermis* Robinson). The male pronotum and anterior tibial spur are less strongly developed than in the other forms, and the male genitalia have the lateral lobes pinched laterally at the apical fourth (Fig. 12, 13). Form 4 was represented in the material examined by two males from Pullman, Washington. They have strongly developed sexual characters in that the pronotum is broader and the lateral borders of the pronotum are more strongly flared than in any of the other forms, the anterior tibial spur is more robust and the male genitalia are strongly inflated with the apex truncate (Fig. 20, 21).

The preceding discussion of the major forms of *alternatus* does not intend to imply that these forms are mutually exclusive. To the contrary, form 3 occurs in the same series with form 2 in Alberta and occurs sporadically in Oregon and Idaho where form 2 is predominant. Forms 1 and 2 both occur in northern California and forms 1 and 3 are both found in Utah. Specimens of form 3 occur in which some or all of the elytral intervals are alutaceous as in form 2. The male genitalia are not constant within any of the forms but rather vary with each population sampled. Figures 12 and 13 illustrate the genitalia of a population of form 1 at one extreme and Fig. 20 and 21 the opposite extreme in form 4. Approximately 250 dissections of male genitalia were made, and all degrees of variation were found to exist as illustrated in Fig. 11–20.

Because members of this species occur in moist areas near streams or standing water, it may be presumed that the distribution of *alternatus* is correlated with the presence of water. This means that there are many areas not inhabited by *alternatus* and the possibility of isolation of populations is great, especially in arid regions. I believe that much of the morphological variation observed is a direct result of such isolation. Contact between proximal populations most likely exists, especially since mass flights do occur, but probably on a sporadic basis which does not allow a continuous gene flow.

Horn (1870–71) stated that he had several specimens from "Bitter Root Valley" (Montana) and "one from an unknown region of California." A single specimen remains in the Horn Collection, a female labeled "Cal/Type No. 3578 *Aphodius alternatus* G. H. Horn (red

paper)/*A. alternatus* Horn." I presume that this is the specimen from California, and I here designate it as lectotype and have so labeled it. From the appearance of the specimen, I judge it to be from somewhere in northern California, probably the Lake Tahoe region. In 1887, Horn said that *alternatus* occurred from "Fort Yuma, California, eastward through Arizona, north to Colorado and the Bitter Root Valley of Montana." None is now in his collection unless the one from "Cal" designated as lectotype is actually from Fort Yuma, which I consider unlikely. I have not seen any specimens of *alternatus* from Arizona. Robinson (1940) described the entirely dark form of *alternatus* as *inermis* based on a single female now in the USNM collection labeled "Utah/Holotype, Aphodius inermis Mark Robinson/Property Mark Robinson/M. Robinson collection 1959/Type 65601 USNM." Hatch (1971) described *moclipsi* from a specimen of *alternatus* with mostly dark elytra. The holotype of *moclipsi* is a male in the Burke Museum collection, University of Washington, labeled "Moclips, Wash. April 6, 1913/Type Aphodius (Calamosternus) moclipsi 1962—M. Hatch/Aphodius sp. near granarius L. M. H. Hatch 1933." I consider both *inermis* and *moclipsi* to be junior synonyms of *alternatus*.

Specimens examined: Total 730 (Fig. 23). ALBERTA: Calgary; Cypress Hills; Empress; Ghost Dam; Medicine Hat; Twp. 7, Rge. 2, W. 5, Mer.; Twp. 14, Rge. 3, W. 4, Mer.; Twp. 21, Rge. 19, W. 4, Mer.; Twp. 24, Rge. 24, W. 4, Mer.; Waiparous; Waterton. BRITISH COLUMBIA: Creston. CALIFORNIA: Alpine Co., Bloods Meadow, 7000 ft; Cedarville; Del Norte Co., Eldorado Co., Pyramid Pk. 8000 ft; Eldorado Co., Whitehall; Hackamore; Humboldt Co.; Lake Co., Warner; Lake of Woods, 7700 ft; Lake Tahoe; Lake Tahoe, Fallen Leaf Lake; Lassen Co., Facht; Lassen Co., Martins Springs; Modoc Co.; Nevada Co., Shotgun L.; San Bernadino Co., Big Bear Lake; Tallac. COLORADO: Alamosa; Antonito; Boulder; La Plata, San Juan Mts.; Steamboat Springs. IDAHO: Coeur d'Alene; Moscow; Cedar Mt.; Pocatello; Wasatch Mts., Bloomington Lake, 8200 ft. IOWA: Ames; Lake Okoboji; Spirit Lake; Thompson. MANITOBA: Aweme; Brandon. MICHIGAN: Iosco Co. MONTANA: Assiniboine; Helena. NEVADA: Elko; Franktown; Reno. NORTH DAKOTA: Billings Co.; Devils Lake; Fargo; Wells Co. OREGON: Bear Springs; Blue Mountains; Coos Co., Fossil Point; Cornelius; Corvallis; Deschutes Co., 10 mi N. of Sisters; Florence, 7 mi S., Siltecos Beach; Forest Grove; Klamath Co., Gearhart Mt., 10 mi NE Blye, 7000 ft; Klamath Co., Horse Glades near Blye; Klamath Co., Kirk; Klamath Co., Klamath Falls; Klamath Co., Merritt Crk.; Klamath Co., Meryl Cr.; Klamath Co., Sprague R., 12 mi E. of Chiloquin; Klamath Falls, Algoma; Klamath Falls, Geary Canal; Klamath Falls, Old Fort Road; Lake Co., Drew Reservoir; Lake Co., Summer Lake; Lane Co., Siltecos Outlet; Lane Co., Winchester Bay; Malheur Lake; Manzanita; McMinnville; Meacham; Neotsu; Seaside; Steens Mountain, Fish Lake, 7500 ft; Tillamook Co., Woods; Tollgate; Trout Creek, Alvord Basin; Upper Klamath Lake; Waldport; Wasco Co., 5.5 mi S. The Dalles; Wasco Co., 7 mi S. Wapinitia. SOUTH DAKOTA: Brookings; Waubay, Blue Dog Lake; Leola;

Volga. UTAH: Boulder, Wilcat Ranger Sta.; Milford; Riverside. WASHINGTON: Cheney; Coulee; Garfield Co., Pomeroy; Grand Coulee; Pullman; Smyrna; Sprague; Stratford; Westport. WISCONSIN: Columbus. WYOMING: Laramie.

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SPICEBUSH AND SASSAFRAS AS NEW NORTH AMERICAN HOSTS
OF ANDROMEDA LACE BUG, *STEPHANITIS TAKEYAI*
(HEMIPTERA: TINGIDAE)

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ABSTRACT—Spicebush, *Lindera bezoin* (L.) Blume, and sassafras, *Sassafras albidum* (Nutt.) Nees., are cited as new North American hosts of the andromeda lace bug, *Stephanitis takeyai* Drake and Maa. Association with and damage to plants is discussed.

The so-called andromeda lace bug was described from Japan as *Tingis globulifera* by Matsumura (1905), who soon (1908) transferred the species to the genus *Stephanitis* Stål. Drake and Maa (1955) discovered the homonymy with *Tingis globulifera* Walker, 1873, and renamed Matsumura's species as *Stephanitis takeyai*.

Bailey (1950) was the first to report *S. takeyai* from North America, based on specimens collected from Japanese andromeda, *Pieris japonica* (Thunb.) D. Don. at Greenwich, Connecticut in 1946. This tingid probably was introduced with nursery stock shipped from Japan (Bailey, 1951). *Stephanitis takeyai* has spread throughout Connecticut, Delaware, Maryland, Massachusetts, New Jersey, Pennsylvania and Rhode Island and occurs in southeastern New York, northern Virginia and eastern Ohio (Dunbar, 1974).

Field and laboratory biology were studied by Dunbar (1974). All known hosts in North America are ericaceous shrubs, although only *Pieris japonica* in home plantings and nurseries has been an important host. Bailey (1974) noted that branches of *Rhododendron calendulaceum* (Michx.) Torr. intermingled with an infested *Pieris japonica* supported a population of andromeda lace bug, and Dunbar (1974) reported *P. floribunda* (Pursh) Benth. & Hook. and a hybrid *Pieris* as suitable but unfavored hosts. In addition, the U.S. National Museum of Natural History (USNM) collection has specimens collected by J. A. Weidhaas on azalea, *Rhododendron* sp., in a nursery at Falls Church, Va., June 3, 1969.

ASSOCIATION WITH SPICEBUSH, *Lindera bezoin* (L.) BLUME

On July 9, 1976, Gary Schuler, a Pennsylvania Department of Agriculture nursery inspector in the Philadelphia area, submitted a sample of spicebush that showed typical symptoms of lace bug injury and that contained two adults of *Stephanitis takeyai*. I was not aware of



Fig. 1. Upper surface of spicebush leaf showing discoloration typical of lace bug injury.

any records of andromeda lace bug breeding on *Lindera*, but I found that Drake and Ruhoff (1965) listed four Asiatic species of *Lindera*, as well as other lauraceous plants, as hosts of *Stephanitis takeyai* in Japan.¹ Since the native *Lindera benzoin* was a new North American host of this introduced species and apparently the only record of any tingid species from spicebush in this country, I attempted to clarify the relationship to the plant.

On July 21, I visited Churchville, Bucks Co., to examine the spicebush plant from which the specimens of *takeyai* had been collected. The plant, about 5 ft high, had volunteered in a home planting of *Pieris japonica* that was heavily infested with lace bugs. Foliage of the spicebush was severely discolored (Fig. 1), and adults and nymphs, plus varnishlike spots of excrement, were present on the undersides of leaves (Fig. 2). Examination of several leaves in the laboratory revealed rows of eggs inserted into midveins.

On the same day another population of *Stephanitis takeyai* was found on spicebush about 10 miles from Churchville. In a nursery near Southampton, a spicebush growing along a stream and about 200 ft from infested *Pieris* was found supporting a smaller population of nymphs and adults. Foliage was only slightly discolored. A third

¹ Another Asiatic species, *Stephanitis ambigua* Horvath, feeds on *Lindera* spp., but the Pennsylvania species is clearly *Stephanitis takeyai*.

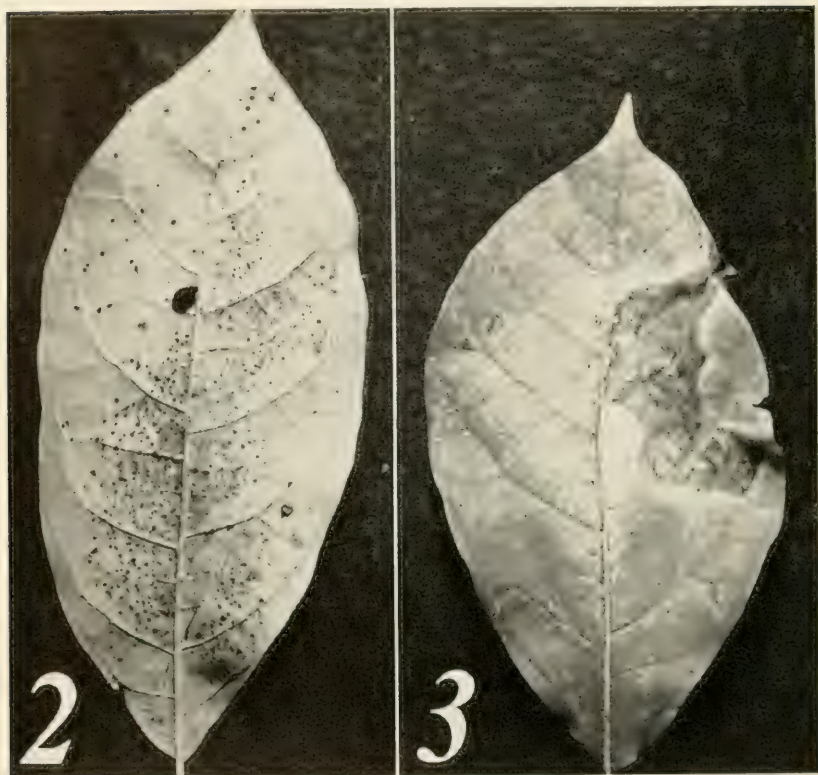


Fig. 2-3. Spicebush leaves damaged by *Stephanitis takeyai*. 2, varnishlike spots of excrement on lower surface. 3, dead tissue resulting from initial feeding injury.

population of lace bugs on spicebush was found in Somerset Co., in western Pennsylvania, on August 10. Adults of *Stephanitis takeyai* were present on a large spicebush growing near a heavily infested *Pieris japonica* in the yard of a nurseryman.

During October, damage was also found on spicebush plants at two locations in Lansdale, Montgomery Co. At these two sites and at the nursery in Southampton, dead tissue was present among discolored areas on many damaged leaves (Fig. 3). Nymphs and adults were no longer present; eggs were found inserted into midveins of leaves.

SASSAFRAS AS A HOST PLANT

On October 5 at the Southampton nursery from which collections had been made earlier from spicebush, leaves showing the character-

istic stippling of lace bug feeding were found on sassafras, *Sassafras albidum* (Nutt.) Nees. Additional plants injured by lace bugs were found in a park in Southampton. Examination of damaged sassafras leaves in the laboratory revealed cast skins of lace bugs, varnishlike spots of excrement, viable eggs inserted in midveins and series of holes on midveins which represented hatched eggs. Although nymphs and adults were not present, it is apparent that sassafras, another member of the Lauraceae, serves as a host of the andromeda lace bug. Lace bug injury on sassafras plants was found near infestations of *Stephanitis takeyai* on *Pieris* or spicebush, and no native tingid species is known to feed on sassafras (Drake and Ruhoff, 1965).

DISCUSSION

In Japan, *S. takeyai* breeds on members of the Ericaceae, Lauraceae, and Styraceae (Drake and Ruhoff, 1965), plant families that are not closely related. Because many European and Asiatic insects have been introduced and have become plant pests in North America, it is useful to compare the host-plant utilization of these species in their native vs. introduced ranges. Other Asiatic hosts of *S. takeyai* which sometimes are grown as ornamentals in this country, e.g., *Styrax japonica* Sieb. & Zucc., may eventually be attacked. Discovery of spicebush and sassafras as hosts of the andromeda lace bug in nurseries and landscape plantings suggests the possibility of these common plants' serving as reservoirs of this pest.

I thank Gary Schuler for making the first collection of *Stephanitis takeyai* from spicebush. T. J. Henry and Dr. K. Valley, Pa. Dept. of Agric., Bur. of Plant Ind., kindly reviewed the manuscript.

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THE DEVELOPMENTAL STAGES OF ENDEODES LECONTE (COLEOPTERA: MELYRIDAE)

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ABSTRACT—The larvae of *Endeodes terminalis* Marshall and *E. rothi* Moore & Legner are described for the first time and a key is given for the five known larvae of the genus. The pupa of *E. terminalis* is described and illustrated for the first time.

The larvae of three species of *Endeodes* have been described (Moore, 1956, 1964). Larvae of two additional species are now available to us. These are described below with a new key to the five known larvae of the nine known species in the genus.

Of the seven species of *Endeodes* which are intertidal in habitat, the larvae are often found with the adults so that larvae of all but two of these (*E. intermedius* and *E. fasciatus*) have been found. Species distribution (see Moore and Legner, 1975) as well as association with adults appears to be a satisfactory criterion for identification of larvae. The larvae of the two species (*E. basalis* and *E. blaisdelli*) which are found under dry seaweed on the berm of the beach have never been found although the adults of *E. basalis* are sometimes common.

KEY TO THE KNOWN LARVAE OF *Endeodes*

1. Body largely piceous 2
Body largely pale 3
2. Urogomphus entirely black *collaris* LeConte
Urogomphus partly or entirely ferrugineous *insularis* Blackwelder
3. Body testaceous or cream colored 4
Body bright ferrugineous *sonorensis* Moore
4. Urogomphus entirely black *terminalis* Marshall
Urogomphus ferrugineous and testaceous *rothi* Moore and Legner

Larva of *Endeodes terminalis* Marshall

Body subparallel. Body and legs testaceous, head ferrugineous, a little paler in front, piceous between and adjacent to ocelli, mandibles piceous at apices, urogomphus entirely piceous. Head nearly square but with anterior margin arcuate; surface finely reticulate, very sparsely finely pubescent with long but fine setae; with 4 ocelli each side, anterior 3 arranged in a straight line along anterior end of frontal suture. Coronal suture meeting frontal suture at an angle of 130°. Mandible with 3 widely separated teeth at apex, central tooth the longest. Antenna very short, retracted into cavity between base of mandible and

ocelli. Labrum membranous, transverse, apex hardly arcuate. Thorax not chitinized, very finely reticulate and dull, clothed in very fine short pubescence, each segment with strong lateral seta. Pronotum $1\frac{1}{2} \times$ as wide as long; mesonotum about as long as pronotum and about $2 \times$ as wide as long; metanotum about the same dimensions as mesonotum. Abdomen subparallel but slightly wider to 5th segment, thence slightly narrowed to 8th segment; surface finely densely microreticulate; pubescence as on thorax; each segment with long lateral seta; each segment, on each side, with depressed ring with tumid center. Urogomphus not quite $2 \times$ as long as wide, finely densely reticulate, clothed in sparse long setae, not segmented, apices each turned up at the end in a small hook. Legs shining, sparsely pubescent. Length 4.5 mm.

One specimen MEXICO, Baja California Norte, Puertecitos, 31 May 1963, T. Palmer collector. In company with 1 adult and 1 pupa (Canadian National Collection).

Larva of *Endeodes rothi* Moore and Legner

Body subparallel. Body and legs pale cream colored, head pale ferrugineous with the area between and adjacent to the ocelli piceous, mandibles piceous at apex, urogomphus pale ferrugineous. Head nearly square but with anterior margin arcuate; surface very finely microreticulate, very finely sparsely pubescent with a few fine long setae; with 4 ocelli each side, the anterior 3 arranged in a straight line along the anterior end of frontal suture. Coronal suture meeting frontal suture at an angle of 130° . Labrum chitinized, apex gently arcuate. Thorax not chitinized, very finely microreticulate and dull, clothed in short sparse pubescence. Pronotum about as wide as long; mesonotum $\frac{2}{3}$ as long as pronotum, $2 \times$ as wide as long; metanotum a little wider and a little longer than mesonotum. Abdomen almost parallel sided but with 8th segment somewhat narrower than the preceding; surface finely densely microreticulate and dull, with fine sparse short pubescence. Urogomphus about $2 \times$ as long as wide, finely densely microreticulate with long fine sparse setae, apices each with a small turned-up hook at tip. Legs shining, sparsely pubescent. Length 3.0 mm.

Three specimens MEXICO, Sonora, Punta Tepoca (29.18–112.20), 22 May 1974, W. Brown & Speich collectors, "on boulders 6" dia. on rocky beach." In company with 14 adults (University of California at Riverside).

Pupa of *Endeodes terminalis* Marshall

Pupa exarate, elongate, pale cream colored throughout, not chitinized in any part. Body with numerous setae, both large and small, none of which arises from a tubercle. Head strongly reflexed so that no part is visible from above; without ocelli; with curved row of about 8 macrosetae along posterior margin; between bases of antennae with 3 rows of setae, 1st row composed of 4 setae, 2nd and 3rd rows composed of 2 setae each; row of 4 setae at base of labrum; labrum about as long as wide, without macrosetae but with a few small scattered setae; mandibles extending a little beyond apex of labrum, slightly hooked at tip, each with a pair of setae at outer edge; antenna curved dorsally over tibiofemoral joint of anterior legs, without setae but with pair of tubercles on dorsal surface of each of the 6 apical segments. Pronotum pentagonal in shape with angles broadly rounded, base about $2 \times$ as wide as apex; strongly arched along center

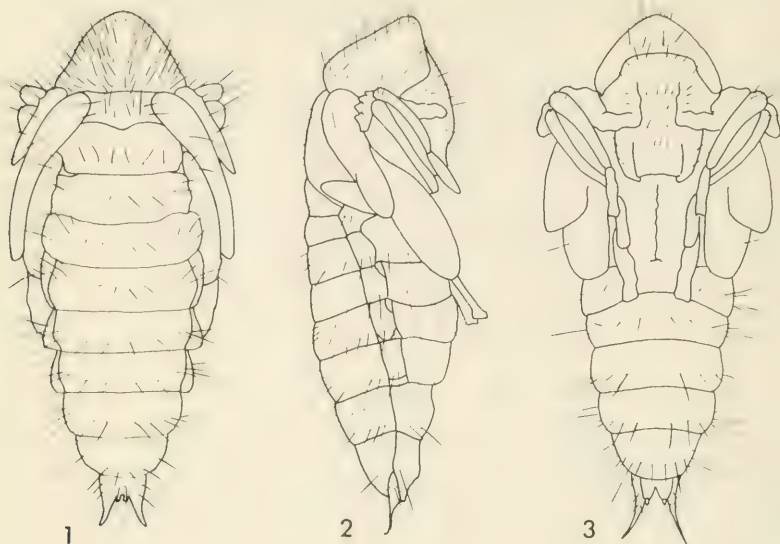


Fig. 1-3. Pupa of *Endeodes terminalis* Marshall. 1, dorsal view. 2, lateral view. 3, ventral view.

line; with numerous setae of various sizes scattered throughout surface; principal macrosetae as follows: Row of 6 evenly spaced along base, 2 or 3 pairs on disc, 1 at each outer angle, 1 midway between outer angle and base, 1 midway between outer angle and apex, 1 pair near apical margin and another pair each slightly basal and lateral to apical pair. Elytra long, narrow, arcuate apressed to the body between middle legs and wings, extending to about apex of 2nd abdominal segment, each with single large seta on disc at basal $\frac{1}{3}$. Wings apressed to the body between elytra and posterior legs, extending not quite to apex of 4th abdominal segment, without setae. Legs slender; the forelegs with group of 3 setae at tibiofemoral joint; middle legs with single seta at tibiofemoral joint; posterior legs without setae. Mesonotum with numerous fine setae and at least 1 row of 3 or 4 macrosetae adjacent to each margin. Metanotum with numerous fine setae and 1 row of 6 macrosetae adjacent to the posterior margin. Abdomen gradually tapered to apex; each segment above and below with row of 4 to 6 discal macrosetae and numerous scattered finer setae. Urogomphus almost as long as penultimate abdominal segment, divided from about the middle into 2 pointed cones, base of each cone broad, tapered gradually to about $\frac{1}{2}$ the distance to apex, thence narrowed slightly and tapered to fine point. An unidentified paired structure ventral to the urogomphus bears a small papilla at apex of each member; the papillae are the only parts visible dorsally. In the tenebrionid genus *Trilobium*, Good (1936) describes a similar structure as "two cone-like appendages similar in appearance to the urogomphi, but shorter . . ." which he says are characteristic of female pupae. Length 3.8 mm.

One specimen MEXICO, Baja California Norte, Puertecitos, 31 May, 1963, T. Palmer collector. In company with 1 adult and 1 larva (Canadian National Collection).

The pupae of Coleoptera are so poorly known that it is difficult to choose with certainty characters which will be of diagnostic value. However, studies by Rozen (1959, 1963a, 1963b) indicate that the location of tuberculate setae on various parts of the body are particularly useful. The pupa of *Endeodes terminalis* has numerous setae of various sizes but none of these arises from a tubercle. Among other characters, a description is given here of the location of the larger setae (macrosetae).

A pupa doubtfully identified as *E. insularis* was illustrated but not described by Moore (1956). The chaetaxy was not indicated. That pupa is easily distinguished from the pupa of *E. terminalis* by its very short elytra which do not reach past the apex of the mesonotum and by the lack of wings.

We gratefully acknowledge the assistance of Lauren D. Anderson, J. Milton Campbell, Vincent Lee, Robert E. Orth, Tom Palmer, William Peet and Vincent Roth in this study.

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THE TAXONOMIC ARRANGEMENT OF THE PHASMATODEA WITH KEYS TO THE SUBFAMILIES AND TRIBES

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ABSTRACT—Keys are presented for the six families, seventeen subfamilies, and thirty-three tribes of Phasmatodea. Lists of genera, synonymies and type-genera are given for each subfamily and tribe.

The Phasmatodea have been less studied than any other order of the Orthopteroidea, are usually referred to as a 'minor order' and have not been monographed in recent years. This paper is an attempt to assist entomologists with the classification of the group by supplying keys to the six families, seventeen subfamilies and thirty-three tribes, for which we give a list of genera, synonymies and type-genera.

We have not settled all the difficulties involved in the taxonomic study of the group, on the contrary there are still problems. Authors disagree as to the position of certain genera in the family-group taxa, and they do not even fully agree on their names or taxonomic limits. The literature of this order also reveals the lack of definite conclusions as to the validity of certain species and genera. There exists a diversity of opinion as to the proper names of certain genera. In this paper lists of genera are given for each subfamily and tribe, but it is not our intent to positively place all the genera in subfamilies or tribes.

Stick insects were first described as Gryllidae and Mantidae by Drury (1773). Latreille (1825) proposed them as a family, now equivalent to an order, using the vernacular name spectra for them. He introduced four genera (*Phillie*, *Phasma*, *Bacterie*, *Bacille*) none of which were cited by a latin name, but which included all the known stick insects. Various names such as Phasmida, Cheleutoptera and Phasmodea were used for this group. Jacobson and Bianchi (1902) introduced the present term Phasmatodea.

The outstanding work on the classification of stick insects by Brunner v. Wattenwyl and Redtenbacher (1906-1908) is considered a virtual starting point for work on this group. It includes keys to fourteen tribes and to many genera and species. The inadequacy of their work stems from the large number of bibliographical errors.

¹ The death of Professor J. C. Bradley on February 25, 1975, left this paper in preparation. For more than a year before his death I helped him with the bibliographical research and late in 1975 I took it on myself to bring this paper to print.

Some of the problems of their work are pointed out by Dohrn (1910), Hebard (1919) and Karny (1923).

Karny (1923) believed that the rules of nomenclature require that the type-genus of each subfamily or tribe must be the oldest contained genus (this is not the case; see International Code Article 64). He therefore attempted to replace many previously established subfamily and tribal names with others that accorded with his view. On this account one must use caution in adopting the family-group names that he employed.

We follow the classification of Dr. Klaus Günther (1953) below the family level, but in reverse sequence, in order to commence with the least specialised, as is customary in phylogenetic treatments. Günther's classification is current and generally accepted. Changes that we have introduced concern nomenclature, only rarely taxonomy. Those genera that Günther mentioned remain where he placed them. Our placement of other genera is based on their descriptions in the literature and complies with the geographical and anatomical divisions set by Günther.

Kristensen (1975) discussed the systematic position of the Phasmatodea, i.e., whether they are a subordinate taxon within the Orthoptera, an isolated group or members of a taxon comprising also Orthoptera. Workers in the past have suggested each of these three different points of view. Burmeister (1838) treated them as a family of the order Orthoptera. Ragge (1955) considered them to be a very isolated group. Beier (1955) and Hennig (1969) considered the Phasmatodea as an order of the superorder Orthopteroidea.

Stål (1875b) divided the order into two major groups according to whether the insects possess areola² or not but did not give names to them. Redtenbacher (1906) named them "Areolatae" and "Anareolatae". Karny (1923), Günther (1953) and Beier (1957) named them Phyllidae and Phasmatidae. We use Redtenbacher's terms and recognize them herein as suborders. Sharov (1968) presented a different division of the order Phasma Phasmatodea. He included two superfamilies, the Xiphopterica represented by fossils and the Chresmodidea represented by the extinct family Chresmididae, and the recent families Phasmatidae and Phyllidae. More fossil material will hopefully supply conclusive evidence.

ORDER PHASMATODEA

Phasmida Leach, 1814-1817:1815.

Phasmodea Burmeister 1838: 553,561.

² Areola—A sharply defined, approximately triangular region situated apically on the meso- and metatibiae. Also called "areola apically tibiarum" by Stål and "area apicalis" by Günther.

Phasmatodea Jacobson and Bianchi, 1902:59; Kevan, 1952:472-485; Günther, 1953:541; Hennig, 1969.

Gressoria Brunner, 1915:195-281.

Cheleutoptera, Phasmida Crampton, 1939:172.

KEY TO THE FAMILIES OF PHASMATODEA

1. Middle and hind tibiae with sunken areola on underside of apices Suborder Areolatae 3
- Middle and hind tibiae without sunken areola on underside of apices Suborder Anareolatae 2
2. Antennae filiform and indistinctly segmented, especially beyond middle, longer than fore femora and often longer than body length; if shorter than fore femora and distinctly jointed, then ventral edge of all femora smooth; ventral carina of middle and hind femora not evenly serrated, usually only with few distal teeth or unarmed Heteronemiidae
- Antennae powerful and distinctly segmented, usually shorter than fore femora, and then female femora are distinctly serrated dorsobasally, or longer than fore femora, but never as long as body, and then ventral carina of middle and hind femora distinctly and evenly serrated Phasmatidae
3. Tarsi clearly 5-segmented 4
- Tarsi apparently 3-segmented; complete mesonotum not more closely attached to the metanotum than to succeeding tergum; legs so attached ventrally that coxae cannot be seen from above; apterous; tarsal claws slightly asymmetrical; large arolium produced as far as apex of longer tarsal claw Timematidae
4. First abdominal segment as long as or longer than metanotum and fused with it 5
- First abdominal segment shorter than metanotum and not fused with it; apterous Bacillidae
5. Antennae long in both sexes; metanotum longer than wide, not leaf-like; margins of abdomen without lateral outgrowths Pseudophasmatidae
- Antennae of female barely as long as head, those of male longer and bristly; metanotum not longer than wide; leaf-like, margins of abdomen strongly foliaceously dilated; leaf-like dilations also on femora and sometimes tibiae; elytra of female covering almost entire abdomen, those of male scarcely longer than thorax Phylliidae

SUBORDER ANAREOLATAE

FAMILY HETERONEMIIDAE

Phasmodea Burmeister, 1838:561.

Bacunculidae Brunner, 1893:80.

Heteroneminae Rehn, 1904a:47.

Heteronemia having been established as the type-genus for a family group, Heteronemiidae (Heteroneminae Rehn, 1904a:47), Kirby (1904a) was not at liberty to change the nominal type-genus to

Diapheromera thereby intending to replace the name *Heteronemiidae* with *Diapheromeridae*.

Rehn (1904a:53) showed that *Bacunculus* Burmeister (1838) is a junior synonym of *Heteronemia* Gray. Brunnner (1893) established the family-group name *Bacunculidae*, but from the preceding, it follows that the family, subfamily and tribal names, each must have the nominal genus *Heteronemia* as its type-genus.

KEY TO THE SUBFAMILIES OF HETERONEMIIDAE

1. Antennae distinctly segmented, usually shorter than fore femora, never as long as body; in those with long antennae ventral carina of posterior femora finely serrated and insects are winged, or their mesonotum is at least as long as metanotum 2
- Antennae filiform and indistinctly segmented, especially beyond middle, longer than fore femora, often longer than body length; ventral carina of 4 posterior femora not evenly serrated, usually only with few distal teeth or completely unarmed; mostly wingless; thin, stick-like animals 3
2. Antennae usually shorter, shorter than fore femora; ventral edge of posterior femora unarmed Pachymorphinae
- Antennae longer than fore femora; ventrolateral edge of posterior femora finely serrated; head with 2 parietal lobes Palophinae
3. Winged or with wing rudiments; if wingless then the mesonotum is longer than metanotum or at least anal segment of male is not split and bilobed and female without beak-shaped ovipositor Necrosciinae
- Wingless (except *Phantasca* Redtenbacher); mesonotum usually shorter than metanotum 4
4. Male anal segment never split and bilobed Heteronemiinae
- Male anal segment split and bilobed, or at least with 2 finger-shaped, curved medioventral processes Lonchodinae

Subfamily Heteronemiinae

Apterophasmina Gray, 1835:14 (in part).

Bacunculus Burmeister, 1838:566.

Heteronemiinae Günther, 1953:561.

KEY TO THE TRIBES OF HETERONEMIINAE

1. Margins of 9th tergum of male turned downward and overlapping ventrally so that the segment, at least apically, appears as closed tube Heteronemiini
- Margins of 9th tergum of male built normally, not ending in closed apical tube Libethrini

Tribe Heteronemiini

Bacteriinae Kirby, 1904a:348.

Bacunculini Brunner, 1907:303.

Diapheromeriinae Karny, 1923:237.

Heteronemiini Günther, 1953:561.

Genera included: *Calynda* Stål, *Diapheromera* Gray, *Heteronemia* Gray, *Litosermyle* Hebard, *Manomera* Rehn, *Ocuophylla* Brunner, *Oncotophasma* Rehn, *Oreophoctes* Rehn (= *Allophylus* Brunner), *Pseudosermyle* Caudell, *Megaphasma* Caudell, *Sermyle* Stål (= *Hoplobethra* Caudell), *Trichopeplus* Shelford. Distribution: America.

Heteronemia Gray, 1835:13,19.

Bacunculus Burmeister, 1838:566. Type-species *Heteronemia mexicana* Gray, monotypy. Distribution: U.S., Mexico, Costa Rica, Ecuador, Brazil.

Diapheromera Gray, 1835:13,18.

Type-species *Diapheromera sayi* Gray [*Diapheromera femorata* (Say) Harris], monotypy. Distribution: America.

Diapheromera and *Heteronemia* are closely related and form a group apart from other *Heteronemiini*.

Oncotophasma Rehn, 1904a:59.

Type-species *Bostra martini* Griffini (*Oncotophasma martini* (Griffini) Rehn), by designation of Rehn, 1904a:60. Distribution: Costa Rica, Colombia.

Pseudosermyle Caudell, 1903:867.

Type-species *Pseudosermyle banksi* by original designation, not *Pseudosermyle arbuscula* as stated by Kirby. Distribution: U.S.

Tribe Libethrini

Phantasis Saussure, 1870:188.

Libethrini Günther, 1953:561.

Genera included: *Bacteria* Kirby (= *Bacunculus* Brunner), *Bactricia* Kirby, *Libethra* Stål (= *Caulonia* Stål), *Libethroidea* Hebard, *Phantasca* Redtenbacher, *Pterolibethra* Günther, *Pseudobacteria* Saussure (= *Dyme* Stål). Distribution: Central and South America, Mozambique, South Africa.

Libethra Stål 1875b:20,74.

Bacteria Westwood, 1859:20 (= *Ceroys* Saussure), (= *Caulonia* Stål), Brunner, 1906–1908:304. Type-species *Libethra nisseri* Stål, by designation of Kirby, 1904a. Distribution: Colombia, Ecuador, Brazil.

Subfamily Lonchodinae

Lonchodidae Brunner, 1893:80,81.

Lonchodinae Rehn, 1904a:38; Kirby, 1904a:317; Günther, 1953:548,560.

Lonchodini Brunner, 1906–1908:239.

Prisomerinae Karny, 1923:236.

KEY TO THE TRIBES OF LONCHODINAE

- Anal segment of male split and extended into 2 lobes and with 2 finger-form processes on hind margin; female operculum simple Lonchodini
- Anal segment of male not truly split but merely with 2 weak but distinct finger-form processes on hind margin; super-anal lamina of female often attached to anal segment without suture, anal segment and operculum elongate, latter bearing an ovipositor shaped like bird's beak Menexenini

Tribe Lonchodini

Lonchoda Brunner, 1893:81.

Prisomerinae Karny, 1923:236.

Lonchodini Günther, 1953:560.

Genera included: *Carausius* Stål, *Chondrostethus* Kirby, *Dixippus* Stål (= *Phasgania* Kirby), *Echinthorax* Günther, *Greenia* Kirby, *Lonchodes* Gray (= *Prisomera* Brunner, not Gray), *Marcenia* Sjöstedt, *Mithrenus* Stål, *Mensilochus* Stål, *Myronides* Stål, *Parasthenoboca* Carl, *Pericentropsis* Günther, *Periphetes* Stål, *Phaortes* Stål, *Phenacephorus* Brunner, *Prisomera* Gray, not Brunner (= *Sthenoboca* Stål), *Pseudosthenoboca* Carl, *Staelonchodes* Kirby (= *Lonchodes* Brunner, not Gray). Distribution: Orient.

Lonchodes Gray, 1835:13,19.

Type-species *Lonchodes brevipes* Gray, by selection of Kirby, 1904a:321. Distribution: Southeast Asia to Australia.

Dixippus Stål, 1875b:9,66.

Type species *Phasma crawangensa* de Haan [*Dixippus crawangensa* (de Haan) Stål], by designation of Rehn 1904a:41 (= *Phasgania* Kirby, 1896:461), type-species *Phasgania everetti* Kirby, 1896:461, by designation of Kirby, 1904a:324. Kirby placed *Phasma crawangensa* in *Phasgania* along with *Phama everetti*, from which it is evident that *Phasgania* is a junior synonym of *Dixippus*. Distribution: Singapore and East Indies.

Myronides Stål, 1875b:3,63.

Type-species *Lonchodes pfeifferae* Westwood [*Myronides pfeifferae* (Westwood) Stål], by designation of Rehn, 1904a:38. Distribution: India and East Indies.

Carausius Stål, 1975b:8,64.

Type-species *Carausius strumosus* Stål, 1875b:64, by designation of Rehn, 1904a:42. Distribution: Southeast Asia.

Echinthorax Günther, 1932a:757.

Type-species *Echinthorax gazellae* (Brunner, 1907) Günther. Distribution: Bismarck, Archipelago.

Tribe Menexenini

Menexi Brunner, 1893:81.

Neopromachini Günther, 1953:560.

Menexenini, revised spelling.

Brunner (1893) established a tribe which he termed *Menexi*, based on the genus *Menexenus*. To him this was both a nominal taxon and a valid taxonomic group. Günther (1953) accepted it as a valid taxonomic tribe but had no right to replace the nominal genus that Brunner had selected with another one of his own choice, *Neopromachus*.

Genera included: *Brachyrtacus* Sharp, *Eupromachus* Brunner, *Hyrtacus* Stål, *Manduria* Stål, *Menexenus* Stål, *Mortites* Günther, *Neopromachus* Giglio-Tos (= *Promachus* Stål). Distribution: Philippines, New Guinea, Australia.

Menexenus Stål, 1875b:73.

Menexus Brunner, 1893:81, a misspelling. Type-species *Acanthoderus lacertinus* Westwood [*Menexenus lacertinus* (Westwood) Stål], monotypy. Distribution: Southeast Asia.

Subfamily Necrosciinae

Necrosidae Brunner, 1893:80,83.

Candaulae Brunner, 1893:83.

Necrosciinae Rehn, 1904a:71.

Necrosciini Redtenbacher, *In* Brunner v. Wattenwyl and Redtenbacher, 1906-1908:470.

Genera included: *Acacus* Brunner, *Anarchodes* Redtenbacher, *Anasceles* Redtenbacher, *Andropromachus* Carl, *Apora* Brunner, *Aruanoidea* Redtenbacher, *Asceles* Redtenbacher, *Aschiphasmodes* Karny, *Asyatata* Redtenbacher, *Battacus* Werner, *Calvisia* Stål, *Candaules* Stål, *Centema* Redtenbacher, *Centrophasma* Redtenbacher, *Cercophylla* Redtenbacher, *Chersaeus* Redtenbacher, *Cylindomena* Günther, *Diagelus* Brunner, *Diacanthoidea* Redtenbacher, *Diardia* Redtenbacher, *Diesbachia* Redtenbacher, *Dilophcephalus* Toledo Piza, *Echinoclonia* Carl, *Eubias* Günther, *Eurynechosia* Dohrn, *Galactea* Redtenbacher, *Gargantuidea* Redtenbacher, *Hemiplasta* Redtenbacher, *Hemisosibia* Redtenbacher, *Lamachodes* Redtenbacher, *Lamachus* Stål, *Leprocaulinus* Uvarov (= *Leprocaulus* Redtenbacher), *Lopaphus* Westwood, not Redtenbacher, *Loxopsis* Westwood, *Malandella* Sjöstedt, *Marmessoidea* Brunner, *Meionecroscia* Redtenbacher, *Mesaner* Redtenbacher, *Micadina* Redtenbacher, *Necroscia* Audinet-Serville, not Redtenbacher, *Necrosciodes* Karny, *Neoclides* Uvarov (= *Neocles* Stål), *Nesciroa* Karny (= *Necroscia* Redtenbacher, not Audinet-Serville), *Orthonecroscia* Kirby (= *Ocellata* Redtenbacher), *Orxines* Stål (= *Lopaphodes* Karny), *Otraleus* Günther, *Oxyartes* Stål, *Pachyscia* Redtenbacher, *Paracentema* Redtenbacher, *Paradiacantha* Redtenbacher, *Paraloxopsis* Günther, *Paramenexenus* Redtenbacher, *Paramyronides* Redtenbacher, *Paranecroscia* Redtenbacher, *Parasipyloidea* Redtenbacher, *Parasosibia* Redtenbacher, *Parasthenoboca* Redtenbacher, *Paroxyartes* Carl, *Prosceles* Uvarov (= *Perisceles* Redtenbacher), *Phaenopharos* Kirby, *Phenacocephalus* Werner, *Platy-*

sosibia Redtenbacher, *Pomposa* Redtenbacher, *Pseudodiacantha* Redtenbacher, *Rhamphosipyloidea* Redtenbacher, *Scionecra* Karny, *Sinophasma* Günther, *Sipyloidea* Brunner, *Sosibia* Stål, *Syringodes* Redtenbacher, *Tagesoidea* Redtenbacher, *Thrasyllus* Stål, *Trachythorax* Redtenbacher, *Trigonophasma* Kirby. Distribution: Southeast Asia, to Australia and Solomon Islands.

Necroscia Audinet-Serville, 1839:250, not Redtenbacher, 1906-1908:557.

= *Necicroa* Karny, 1923:242. Type-species *Necicroa terminalis* Redtenbacher, by designation of Karny. Type-species *Necroscia roscipennis* Audinet-Serville, 1839:252, by designation of Kirby, 1904a:374. Distribution: Southeast Asia and Africa.

Aruanoidea Brunner, 1893:84.

Type-species *Necroscia marmessus* Westwood [*Marmessoides marmessus* (Westwood) Brunner], by indication of Brunner, 1893 and acceptance by Rehn, 1904a:73. Kirby incorrectly designated *Mantis rosca* F. to be the type-species of Marmessoidea. Distribution: Southeast Asia.

Sosibia Stål, 1875b:42,87.

Type-species *Sosibia nigrispina* Stål, by designation of Rehn, 1904a:71. Distribution: Southeast Asia.

Sipyloidea Brunner, 1893:84,86.

Type-species *Necroscia sipylus* Westwood [*Sipyloidea sipylus* (Westwood) Brunner], by indication of Brunner, 1893, and acceptance by Rehn, 1904a:76. Distribution: Southeast Asia.

Calvisia Stål, 1875b:42,87.

Type-species *Necroscia sangarius* Westwood [*Calvisia sangarius* (Westwood) Stål], by designation of Rehn, 1904a:71. Distribution: Southeast Asia.

Orxines Stål, 1875b:43,87.

Type-species *Anophlepis xiphias* Westwood [*Orxines xiphias* (Westwood) Stål], by designation of Rehn, 1904a:71, not *Phasma macklottii* Haan, as stated by Kirby, 1904a:367. Distribution: Southeast Asia.

Subfamily Pachymorphinae

Pachymorphae Brunner, 1893:89.

Clitunnini Brunner, *In* Brunner v. Wattenwyl and Redtenbacher 1906-1908:181, invalid.

Pachymorphinae Karny, 1923:235; Günther, 1943:559; Beier, 1968:7.

KEY TO THE TRIBES OF PACHYMORPHINAE

We are unable to present a proper key to these tribes but the following notes and the paragraph translated from Günther may be helpful.

- Anal segment in male truncate or slightly emarginate, that of female variable; antennae shorter than anterior femora; 2nd abdominal segment

- 2× longer than wide; cerci sometimes elongate but never with dilated lobes; middle and posterior femora unarmed or rarely spinulose Ramulini
- Differing from preceding in having antennae as long as anterior femora or longer, and cerci foliate-rounded; anterior femora dentate beneath Pachymorphini
- African and Malagasy species that Brunner incorrectly placed in *Pachymorpha* Gray (i.e. *Pachymorpha madagassa* Brunner, *P. distincta* Brunner, *P. omphala* Westwood, *P. tricarinata* Brunner, *P. sansibarica* Brunner, *P. congensis* Brunner) and possibly a species in Celebes and 2 in New Guinea Hemipachymorphini

Paragraph translated from Günther, 1953: "As Pachymorphinae I include the apterous species with short antennae that come mostly from East Africa which Brunner grouped around *Ramulus* Saussure (= *Gratidia* Stål), for the most part properly; these form the tribe Ramulini which Brunner included as part of his tribe Clitumnini. The many species of *Ramulus* occur in Africa, south of Sahara, and a few species in Madagascar, Persia, Central Asia, India and Java. The closely related *Leptinia* Pantel has a few species in southern Europe besides those in Africa. Here also belong the partly highly-specialized genera *Phthoa* Karsch, *Zehntneria* Brunner, from South Africa, and *Burria* Brunner from Somaliland, as well as *Macella* Stål and *Gongylopus* Brunner from China and Cochin. *Parapachymorpha* Brunner, with three species from Burma and New Guinea, belongs in or near the genus *Dimorphodes* Westwood in the subfamily Xeroderinae, q.v. I place the genus *Pachymorpha* sense of Kirby, not Gray, in tribe two, Hemipachymorphini. That genus contains the African and Malagasy species which Brunner, incorrectly, placed in *Pachymorpha* Gray. Its relationship with the Ramulini (here called Clitumnini) is doubtful; the true relationships for the following genera, also placed in this tribe, are wholly obscure; *Dagys* Günther, *Pachymorpha epidicus* Günther (1935) from Celebes; *Pseudopromachus* Günther (1929) and *Oreophasma* Günther (1929) both from New Guinea. Finally, I place here as the third tribe Pachymorphini, the Australian and New Zealand genera *Pachymorpha* Gray, *Mimarchus* Carl, *Micrarchus* Carl, and the wholly questionable *Acanthoderus* Gray, not Brunner nor Karny. The Pachymorphinae probably do not form a natural group in this arrangement."

Tribe Pachymorphini

Pachymorphae Brunner, 1893:89.

Pachymorphini Günther, 1953:559.

Genera included: *Acanthoderus* Gray (not Brunner, nor Karny) *Micrarchus* Carl, *Mimarchus* Carl, *Pachymorpha* Gray (not Brunner). Distribution: Africa, South Europe, Madagascar, Asia, Australia, New Guinea, New Zealand.

Pachymorpha Gray, 1835:13,21.

Type-species *Pachymorpha squalida* Gray, 1835:21, by monotypy. Gray designated *Bacillus squalidus* Gray, 1833:18, as a synonym of *P. squalida* Gray 1835; but, since he designated the latter as a new species, the synonymy technically became subjective. Distribution: Australia, Papua, New Zealand.

Tribe Hemipachymorphini

Hemipachymorphini Günther, 1953:559.

Taxa included: *Dagys* Günther, *Hemipachymorpha* Kirby, *Oreophasma* Günther, *Pseudopromachus* Günther, *Tectarchus* Salmon. Distribution: Africa, Madagascar, Papua Celebes.

Hemipachymorpha Kirby, 1904a:341.

Type-species *Pachymorpha omphale* Westwood [*Hemipachymorpha omphale* (Westwood) Kirby], by designation of Kirby, 1904a:341. Distribution: South Africa.

Tribe Ramulini

Clitumnidae Brunner, 1893:87.

Clitumninae Caudell, 1903:865.

Ramulini Günther, 1953:559.

Genera included: *Burria* Brunner, *Cerasticus* Caudell, *Gongylopus* Brunner, *Leptynia* Pantel, *Leptyniella* Bolivar, *Macellina* Uvarov (= *Macella* Stål), *Parabacillus* Caudell, *Paraleptynia* Caudell, *Parapachymorpha* Brunner, *Phthoa* Karsch, *Ramulus* Saussure (= *Gratidia* Stål), *Steleoxiphus* Rehn, *Wattenwylia* Toledo Piza, *Xiphophasma* Rehn, *Zehntneria* Brunner. Distribution: Africa, Madagascar, Southern Europe, Central Asia, China.

Parapachymorpha Brunner, 1893:95.

Type-species *Parapachymorpha nigra* Brunner, by designation of Kirby, 1904a:342. Distribution: Burma, Philippines.

Macellina Uvarov, 1940:112.

Type-species *Bacillus souchongia* Westwood [*Macella souchongia* (Westwood) Stål], by designation of Rehn, 1904a:80; *Macella* an occupied name. Distribution: Southeast Asia.

Subfamily Palophine

Palophinae Kirby, 1896:465; Beier, 1968:7.

Palophi Redtenbacher, 1908:391.

Genera included: *Bactrododema* Stål, not Redtenbacher, *Dematobactron* Karny (= *Bactrododema* Redtenbacher, not Stål), *Ischnophasma* Uvarov (= *Ischnopoda* Grandidier), *Palophus* Westwood. Distribution: Africa.

Bactrododema Stål, 1859a:308.

Type-species *Bactrododema tiarata* Stål, by designation of Rehn, 1904a:70.
Distribution: Africa.

KEY TO THE SUBFAMILIES OF PHASMATIDAE

1. Anterior femora rarely triangular in cross section, but if they are, then neither serrate nor dentate at base (Exception: apterous Cladoxerini); anterior femora usually with four distinct carina, and if so not serrate at base nor on upper carina 2
- Anterior femora approximately triangular in cross section, serrate at least dorsobasally; either with wing rudiments or with mesonotum longer than metanotum; some small, apterous species in Burma and Indonesia with dorsobasally smooth fore femora, a short mesonotum, and ahal segment of male cleft Phasmatinae
2. Female operculum sometimes extends for some distance over apex of abdomen. America, Madagascar Cladomorphinae
- Female operculum simple, Old World forms, mainly Indo-Australian 3
3. Operculum of female and elongate supra-anal lamina form beak-shaped ovipositor, often attached without suture; posterior femora of male often thickened and armed. Melanesia to Fiji Eurycanthinae
- Female operculum and supra-anal lamina do not form a beak-shaped ovipositor; hind femora of male never thickened or armed 4
4. Ventrolateral carinae of middle and hind femora finely serrate or smooth; anterior femora not compressed at base 5
- Femora with blunt teeth or lobes on carinae; anterior femora distinctly compressed. Melanesia, Celebes, New Guinea, Australia Xeroderinae
5. Cheeks not broader than eye; wings usually well developed, elytra elongate oval, weakly umbonate. Australia, New Guinea, Madagascar Tropidoderinae
- Cheeks broader than eye; elytra and often wings short or wanting. New Guinea, Philippines, Moluccas, Greater Sunda Islands Platycraninae

Subfamily Cladomorphinae

Bacteridae Brunner, 1893:83.

Cladomorphidae Brunner, 1893:90,98.

Bacterinae Rehn, 1904a:61.

Bacteriinae Kirby, 1904a:348.

Phibalosomini Redtenbacher. In Brunner v. Wattenwyl and Redtenbacher, 1906-1908:339.

Phibalosominae Chopard, 1912:343; Günther, 1953:557.

Phibalosomidae Brunner, 1915:233.

Diapheromerinae Karny, 1923:237.

Cladoxerinae Karny, 1923:237.

Phibalosomatinae Moxey, 1971:67.

Cladomorphinae NEW STATUS for Cladomorphidae Brunner.

KEY TO THE TRIBES OF CLADOMORPHINAE

1. Antennae of female longer than anterior femur 2
- Antennae of female much shorter than anterior femur Cladoxerini
2. Inferior median carina of anterior femora midway between anterior and posterior carinae 3
- Inferior median carina of anterior femora approaching anterior inferior carina; females without rudiments of wings Cladomorphini
3. Both sexes with rudiments of wings. Central America and Antilles Hesperophasmatini
- Females without rudiments of wings; males unknown. Tropical South America Craspedoniini

Tribe Craspedoniini

Cranidiini Günther, 1953:557.

Craspedoniini nomen n.

Genus *Craspedonia* Westwood, 1843:25.

Craspedonia Westwood, 1843:25.

Cranidium Westwood, 1843:49, described as subgenus of *Diapherodes* Gray. *Phasmilliger* Carrera, 1960:100. Type-species of *Craspedonia*: *Phasma* (*Craspedonia*) *gibbosa* Burmeister [*Craspedonia gibbosa* (Burmeister) Westwood], by monotypy. Type-species of *Cranidium*: *Diapherodes* (*Cranidium*) *serricolis* Westwood [*Craspedonia gibbosa* (Burmeister) Westwood], by present designation. Type-species of *Phasmilliger*: *Phasmilliger* (*Diapherodes*) *gibbosus* (Burmeister) Carrera.

Westwood synonymized the type-species of his new subgenus *Craspedonia* (1842) with *Diapherodes gibbosa* Burmeister (1838) and as he gave no authority for the species that he called *Phasma* (*Craspedonia*) *gibbosa*, the synonymy is not only correct but may be regarded as objective. The type-species is therefore *Diapherodes gibbosa* Burmeister, and not *Diapherodes* (*Craspedonia*) *undulata* Westwood, as stated by Kirby, 1940a:387.

In the early years of the nineteenth century, Illiger, the curator of insects in the Humboldt Museum in Berlin, intended to describe two specimens of a species of stick insect from Brazil under the name *Cranidium* but never published his work. Burmeister (1838, 2: 574), in discussing the genus *Diapherodes*, noted that Illiger had used the name *Cranidium* in manuscript for a part of *Diapherodes* but he did not accept that name. His having mentioned this manuscript name gave it no status, nor did it make it unavailable for future work. Westwood was within his rights when he established *Cranidium* as a subgenus of *Diapherodes*. Carrera mistakenly thought that Burmeister (1838) invalidated the name *Cranidium* by using it and erected a new genus for *gibbosa*, namely, *Phasmilliger*. Redtenbacher (1906-1908:435) accepted the genus *Cranidium* but incorrectly at-

tributed it to Burmeister; he included only one species which he called *Cranidium gibbosa* Burmeister.

Distribution: Brazil, Venezuela, French Guiana.

Tribe Hesperphasmatini

Phantases Brunner, 1893:82 (in part) a vernacular plural name derived from the preoccupied name *Phantasis*.

Bacterae Brunner, 1893:83 (in part).

Haplopodini Günther, 1953:557.

Hesperphasmatini Rehn, 1901:271.

Brunner made *Phantasis* Saussure the type-genus of a family group, but *Phantasis* was preoccupied, and Rehn replaced it with the nominal genus *Hesperophasma* Rehn, which must therefore be the type-genus of the tribe which Günther called "*Haplopodini*"; although Rehn initially placed it in *Heteronemiinae*.

Genera included: *Agamemnon* Moxey, *Aploploides* Rehn and Hebard, *Aplopus* Gray, *Bostra* Stål, *Clonistria* Stål, *Diapherodes* Gray, not Kaup, *Hesperophasma* Rehn (*Phantasis* Saussure preoccupied) *Lamponius* Stal (= *Antillophilus* Carl, *Pterinoxylus* Audinet-Serville, *Taraxippus* Moxey, *Tersomia* Kirby.

Rehn and Hebard (1938) indicate the taxonomic difficulties in this area. At present *Clonistria* is separated from *Bostra* only by having the metatarsus sulcate in the former and carinate in the latter. The type-species of *Clonistria*, Stål's *bartholomea*, is further separated from the type-species of *Bostra*, Westwood's *Bacteria turgida*, by having the mesonotum equal in length to the metanotum while *Bostra* has the mesonotum half as long as the metanotum. Unfortunately, in males, it is often difficult to decide whether the metatarsus is sulcate or carinate; this grades from one to the other through different species.

Hesperophasma Rehn, 1901:271.

Phantasis Saussure, 1870:188, preoccupied by *Phantasis* Thomson. Type-species *Phasma planulum* Westwood [*Hesperophasma planulum* (Westwood) Rehn] by designation of Rehn, 1904a:47, not *Phantasis saussurei* Bolivar as stated by Kirby. Distribution: Cuba, San Domingo.

Aplopus Gray, 1835:34.

Haplopus Burmeister, 1838:576; Kirby, 1904a:363; Redtenbacher, 1906-1908:429. Type-species *Aplopus micropterus* Gray (with which Gray subjectively synonymized *Phasma angulata* Stoll and *Cyphocrana microptera* Latreille, Lepeletier de Saint-Fargeau, Audinet-Serville and Guérin) by monotypy, not *Mantis jamaicensis* Drury as stated by Kirby, which was not an originally included species. Rehn and Hebard (1938:52) suggested that the strong struc-

tural features in certain species of *Aplopus* and *Diapherodes* may indicate generic units that have not yet been discovered. Distribution: Central America and Caribbean Islands.

Postra Stål, 1875a:6,13.

Type-species *Bostra turgida* (Westwood) Stal, by monotypy. Distribution: Central and South America. This genus was placed in *Heteronemiinae* by Rehn (1904a:57) and by Hebard (1919), thus removing it from the *Cladomorphinae* where Redtenbacher had placed it, but Rehn and Hebard (1938) returned it to the '*Phibalosominae*'; they noted that it was very close to *Calynnda* Stal, differing only in character of the metatarsi.

Clonistria Stål, 1875a:6,13,16.

Type-species *Clonistria bartholomaea* Stål, by monotypy. Rehn and Hebard (1938:41) indicated that this name may prove to be a synonym of *Mantis linearis* Drury. Distribution: West Indies.

Diapherodes Gray 1835:13,33.

Type-species *Diapherodes gigas* Drury. Distribution: Antilles. Gray (1835) used Drury's (1773) *Mantis gigas*. Although this name was then preoccupied by *Gryllus* (*Mantis*) *gigas* Linné (1788), by placing it in a new genus (i.e., *Diapherodes*) it was no longer a junior homonym and could thus be resurrected, and, being the oldest name, has priority.

Tribe Cladoxerini

Cladoxerinae Karny, 1923:237.

Cladoxerini Günther, 1953:557.

Genera included: *Cladoxerus* Latreille, Lepeletier de Saint-Fargeau, Audinet-Serville, Guérin, *Parabactridium* Redtenbacher. Distribution: South America and Madagascar.

Cladoxerus Latreille, Lepeletier de Saint-Fargeau, Audinet-Serville, Guérin, 1825: 445.

Bactridium Redtenbacher, 1906-1908:400, not Saussure, 1868:66. Type-species of *Cladoxerus*: *Cladoxerus gracilis* Latreille, Lepeletier de Saint-Fargeau, Audinet-Serville, and Guérin, by monotypy. Type-species of *Bactridium*: *Bactridium coulouianum* Saussure, by monotypy. Distribution: Brazil and British Guiana.

Redtenbacher (1906-1908:400) synonymized *Cladoxerus* with *Bactridium* by placing its type-species *Cladoxerus gracilis* in *Bactridium* but failed to adopt *Cladoxerus* (1825) instead of *Bactridium* (1868). Karny (1923:237) adopted the same *Cladoxerus*, supposing *gracilis* to be the type-species.

Tribe Cladomorphini

Bacteriae Brunner, 1893:83.

Cladomorphi Brunner, 1893:98.

Phibalosomini Günther, 1953:557.

Phibalosomatinae Moxey, 1971:67.

Cladomorphini, revised form of tribal name.

Genera included: *Bacteria* Latreille, Lepeletier de Saint-Fargeau, Audinet-Serville, Guérin (= *Phanocles* Stål), *Cladomorphus* Gray, *Hirtuleius* Stål. Distribution: Brazil and French Guiana.

Cladomorphus Gray, 1835:12,15.

Phibalosoma Gray, 1835:14,42. Type-species of *Cladomorphus*: *Phibalosoma lepelletieri* i.e. *lepelletieri* Gray (*Cladomorphus lepelletieri* Gray). Kaup (1871) said that there are 2 groups of *Phibalosoma*, 1 in which the 1st segments of the tarsi are only as long as the 2 following segments, the other with the 1st segments of the tarsi as long as the remaining segments taken together. To the 1st group he assigned *ceratocephalus*, by which he meant *Cladomorphus ceratocephalus* Gray, and *Phibalosoma lepelletieri* Gray which he designated type. Although he did not mention the name *Cladomorphus* he thus effectively designated *Phibalosoma lepelletieri* as the type of *Cladomorphus*. Type-species of *Phibalosoma*: *Phibalosoma lepelletieri* Gray (*Cladomorphus phyllinus* Gray) by monotypy. Distribution: French Guiana and Brazil.

According to Kirby, *Phibalosoma lepelletieri* Gray is a synonym of *Cladomorphus phyllinus* Gray, but this synonymy is subjective; if correct, and we have no reason to doubt it, then *Cladomorphus* and *Phibalosoma* are synonyms and the act of the first reviser determined which of the two names must endure. Burmeister (1838) was the first reviser; under the genus *Cladoxerus* he referred to *Cladoxerus phyllinus* Gray, but he nowhere mentioned *Phibalosoma*, which therefore is no longer valid despite its considerable usage following Westwood (1859). Brunner (1893:98) adopted the generic name *Cladomorphus*.

Bacteria Latreille, Lepeletier de Saint-Fargeau, Audinet-Serville, Guérin, 1825:446.

Type-species *Mantis ferula* F. (*Bacteria ferula* (F.) Latreille et al.) by designation of Rehn (1904a); but in his discussion it is obvious that he intended the type to be the species figured by Stoll (*baculus* not *ferula*) and thus he was using *ferula* in the sense of Lichtenstein (1802). However Redtenbacher synonymized *Mantis ferula* with *Phasma aromatica* Stoll which Kirby synonymized with *Mantis baculus*. Distribution: West Indies and British, Dutch and French Guiana.

Hirtuleius Stål, 1875b:29.

Type-species *Hirtuleius laeviceps* Stål, by monotypy. Distribution: Brazil, French Guiana.

Subfamily Platycraninae

Platycraninae Brunner, 1893-97.

Platycraniinae Günther, 1953:567.

Genera included: *Acanthograeffea* Günther, *Anophelepis* Westwood, *Brachyrhamphus* Carl, *Echelus* Stål (= *Ernodes* Redtenbacher, not Wallengren), *Elicius* Günther, *Erastus* Redtenbacher, *Graeffea* Brunner, *Megacrania* Kaup, *Ommatopseudes* Günther, *Ophicrania* Kaup (= *Arridaeus* Stål, = *Apterrhidaeus* Karny) *Platycrana* Gray, *Xenomaces* Kirby. Distribution: Orient, East Indies, New Guinea, Australia, Moluccas, Philippines, Melanesia.

Platycrana Gray, 1835:36.

Platycrania Westwood, 1859:112.

Type-species *Platycrana viridana* Gray, by designation of Karny, 1923. Distribution: East Indies, Philippines.

Ophicrania Kaup, 1871:38.

Type-species *Ophicrania striatocollis* Kaup, by monotypy (= *Arrhidaeus* Stål, 1875b:15. Type-species *Necrosia stygius* i.e. *stygius* Westwood, 1859:136). *Ophicrania stygius* (Westwood) NEW COMBINATION, by designation of Rehn, 1904a:85. Distribution: Philippines, Indonesia.

Graeffea Brunner, 1868:46.

Type-species *Graeffea purpuripennis* Brunner [*Graeffea crouanii* (Le Guillou 1841) Kirby], by monotypy. Distribution: Samoa. Rehn (1904a:85) gave Stål (1875b) as author of *Graeffea* and designated *Lopaphus coccophagus* Westwood, a subjective synonym of *Graeffea crouanii*, as type.

Subfamily Xeroderinae

Xeroderinae Günther, 1953:556.

Genera included: *Cotylosoma* Wood Mason, *Cooktownia* Sjöstedt, *Epicharmus* Stål, *Leostenes* Stål, *Nisyrtus* Stål, *Xenophasmina* Uvarov (= *Xenophasma* Redtenbacher), *Xeroderus* Gray. Distribution: Orient, Mauritius, Australia, New Guinea, Melanesia.

Xeroderus Gray, 1835:32.

Type-species *Xeroderus kirbii* Gray, by monotypy. Distribution: Australia.

Subfamily Eurycanthinae

Eurycanthae Brunner, 1893:89.

Eurycanthinae Kirby, 1904a:395.

Genera included: *Acanthodyta* Sharp, *Asprenas* Stål, *Canachus* Stål, *Cnispus* Redtenbacher, *Dryococelus* Gurney, *Eurycantha* Boisduval, *Labidiophasma* Carl, *Paracanachus* Carl, *Poecilobactron* Günther, *Thaumatobactron* Günther, *Trapezaspis* Redtenbacher. Distribution: New Guinea, Western Pacific.

Eurycantha Boisduval, 1835:647.

Karabidion Montrouzier, 1855.

Type-species *Eurycantha horrida* Boisduval, by monotypy. Distribution: New Guinea, Western Pacific.

Subfamily Phasmatinae

Acrophyllae Brunner, 1893:97.

Acrophyllinae Kirby, 1904a:379.

Phasminae Karny, 1923:240; Günther, 1953:554.

Phasmatinae, corrected spelling.

KEY TO THE TRIBES OF PHASMATINAE

- | | |
|---|-----------------|
| 1. Both sexes, or at least female, apterous | 6 |
| — Both sexes alate or with wing rudiments | 2 |
| 2. Cerci of female short and slender; male without ocelli; elytra or wings of female often strongly reduced | 3 |
| — Cerci of female strongly flattened and widened or elongate and lanceolate; ocelli of male distinct | Phasmatini |
| 3. Operculum of female not exceptionally long | 5 |
| — Operculum of female extended broadly over apex of abdomen | 4 |
| 4. Body slender, elongate, unarmed; no elytra | Phasmatenionema |
| — Body elongate, spinose; elytra elongate-oval | Achriopterini |
| 5. Head swollen; middle and hind femora with tooth-like, serrate inferior carinae. New Guinea | Stephanacridini |
| — Head flattened; middle and posterior femora at most with few little thorns at apex. Australia | Acanthomimini |
| 6. Both sexes completely lacking organs of flight; median segment distinctly shorter than metanotum, usually much shorter | 7 |
| — Male alate; median segment of female almost or completely as long as metanotum | Pharnaciini |
| 7. Ceylon, India, Indonesia | Baculini |
| — Australia, New Zealand | Acanthoxylini |

"Among these tribes many unnatural relationships are probably established or too broadly established; the Pharnaciini and Baculini especially are probably not so close and research on the anal segments of the male will very likely cause other allotment." Günther (1953:555).

Tribe Acanthoxylini

Macracanthini Günther, 1953:555.

Acanthoxylini, by present designation.

Genera included: *Acanthoxyla* Uvarov (= *Macracantha* Kirby), *Argosarchus* Brunner, *Arphax* Stal, *Clitharchus* Stal. Distribution: Australia, New Zealand.

Acanthoxyla Uvarov, 1944. n.n. for *Macracantha* Kirby, not Simon.

Macracantha Kirby, 1904a:340. *Acanthoderus* Brunner, 1906–1908:238. Type-species *Acanthoderus prasinus* Westwood [*Macracantha prasinus* (Westwood) Kirby], by designation of Kirby, 1904a:340. Distribution: New Zealand.

Tribe Baculini

Baculini Günther, 1953:555.

Genera included: *Baculum* Saussure (= *Clitumnus* Stål, = *Cuniculina* Brunner), *Ectentoria* Brunner, *Entoria* Stål, *Erringtonia* Brunner, *Gharianus* Werner, *Medaura* Stål (cf. Carl, 1913; Günther, 1932a), *Metentoria* Brunner, *Nesiophasma* Günther, *Paraclitumnus* Brunner (= *Dureulia* Brunner), *Phobaeticus* Brunner, *Phryganistria* Stål, *Prosentoria* Brunner, *Rhamphophasma* Brunner, *Woodmasonia* Brunner. Distribution: India, Ceylon, East Indies.

Baculum Saussure, 1870:292.

Clitumnus Stål, 1875b:66. *Entoria* Stål, 1875b:15,72. Type-species of *Baculum*: *Bacillus cuniculus* Westwood [*Baculum cuniculus* (Westwood) Kirby], by designation of Kirby, 1904a:327. Type-species of *Clitumnus*: Stål (1875b:67) referred several species to *Clitumnus* but stated that none of them had been determined with certainty. The first species that Stål mentioned is *Lonchodes nemotodes* Haan, but he included it in the synonymy of *Dixippus crawangensis* on the preceding page. Type-species of *Entoria*: *Entoria denticornis* Stål, 1875b:72 [*Baculum denticorne* (Stål) Kirby], by designation of Kirby, 1904a. Distribution: Orient.

Tribe Pharnaciini

Pharnaciini Günther, 1953:555.

Genera included: *Cladomimus* Carl, *Diagoras* Stål, *Eucarcharus* Brunner, *Gigantophasma* Sharp, *Hermarchus* Stål, *Lobophasma* Günther, *Nearchus* Redtenbacher, *Pharnacia* Stål, *Phasmatotenionema* Navas (= *Taeniosoma* Bolivar, *Taenionema* Kirby) *Sadyattes* Stål, *Tirachioidea* Brunner. Distribution: Southeast Asia, Philippines, Melanesia, Polynesia, Australia.

Pharnacia Stål, 1877:40.

Type-species *Pharnacia ponderosa* Stål, by designation of Kirby, 1904a:359. Distribution: India, East Indies, Philippines.

Tirachioidea Brunner, 1893:83.

Type-species *Phibalosoma cantori* Westwood [*Tirachioidea cantori* (Westwood) Brunner], by designation of Rehn, 1904a:70. Distribution: Ceylon, Southeast Asia.

Tribe Acanthomimini

Acanthomimini Günther, 1953:555.

Genera included: *Acanthomima* Kirby (= *Ectus* Redtenbacher and probably *Caruacia* Sjöstedt, 1918). Distribution: Australia.

Acanthomima Kirby, 1904a:438.

Type-species *Anophelepis rhipheus* Westwood [*Acanthomima rhipheus* (Westwood) Kirby], by monotypy. Distribution: Australia.

Tribe Achriopterini

Achriopterini Günther, 1953:555.

Genera included: *Achrioptera* Coquerel, *Hovaspectrum* Rehn. Distribution: Madagascar.

Achrioptera Coquerel, 1861:495.

Type-species *Achrioptera fallax* Coquerel, by monotypy. Distribution: Madagascar.

Tribe Stephanacridini

Stephanacridini Günther 1953:555.

Genus: *Stephanacris* Redtenbacher. Distribution: New Guinea.

Stephanacris Redtenbacher, 1906-1908:441.

Type-species *Stephanacris brevipes* Redtenbacher, by present designation. Distribution: New Guinea.

Tribe Phasmatini

Phasmata Brunner, 1893:99.

Acrophyllae Brunner, 1893:97.

Acrophyllinae Kirby, 1904a:379 (in part).

Acrophillini Redtenbacher, 1906-1908:436.

Phasminae Karny, 1923:240.

Phasmini Günther, 1953:555.

Phasmatini, corrected spelling.

Genera included: *Acrophylla* Gray, *Anchiale* Stål, *Ctenomorpha* Gray, *Ctenomorphodes* Karny, *Eurycnema* Audinet-Serville (= *Clemacantha* Rainbow), *Onchestus* Stål, *Papuanoides* Paracyphocrania Redtenbacher, *Paronchestus* Redtenbacher, *Pelorian* Uvarov (= *Peloria* Redtenbacher), *Phasma* Lichtenstein (= *Cyphocrania* Lapeletier de Saint-Fargeau and Audinet-Serville), *Vetilia* Stål. Distribution: Southeast Asia to New Zealand.

Phasma Lichtenstein, 1796:77.

Type-species *Phasma empusa* Lichtenstein, by designation of Kirby, 1904a:390. Distribution: Amboina, New Guinea.

Subfamily Tropidoderinae

Tropidoderi Brunner, 1893:97.

Podacanthinae Günther, 1953:553.

Tropidoderinae, revised subfamily name.

KEY TO THE TRIBES OF TROPIDODERINAE

- Wings and elytra more or less evident in each sex; inner carina of under surface of posterior tibiae of male without strong spines Tropidoderini
- Female apterous or with rudimentary elytra, male apterous or alate; in latter case inner carina of under surface of posterior tibiae of male spinose Monandropterini

Tribe Monandropterini

Monandropterae Brunner, 1893:97.

Raphiderini Günther, 1953:553.

Monandropterini, corrected tribal name.

Genera included: *Heterophasma* Redtenbacher, *Monandroptera* Audinet-Serville, *Raphiderus* Audinet-Serville. Distribution: Philippines, Vietnam, East Indies, Algeria(?).

Monandroptera Audinet-Serville, 1839:242.

Type-species *Monandroptera inuncans* Audinet-Serville [*Monandroptera acanthomera* (Burmeister) Kirby], by monotypy.

Westwood (1841–1845, 2:25, pl. 8) figured an insect which he incorrectly identified as “*Phasma* (*Craspedonia*) *gibbosa* (Burmeister)”; the error being pointed to him, he changed the identification to “*Diapherodes* (*Craspedonia*) *undulata* n.sp.”. In 1860:80, realizing that the insect figured does not belong to *Diapherodes*, he transferred it to the genus *Monandroptera* and indicated that it probably came from Africa. We do not believe that it is a true *Monandroptera*, but rather a species of *Raphiderus* that has been recorded from Algeria.

Tribe Tropidoderini

Tropidoderini Brunner, 1893:97.

Podacanthini Günther, 1953:553.

Genera included: *Athertonina* Sjöstedt, *Didymuria* Kirby (= *Diura* Gray), *Kimberleyana* Sjöstedt, *Lysicles* Stål, *Malandania* Sjöstedt, *Podacanthus* Gray, *Tropidoderus* Gray, *Vasilissa* Kirby. Distribution: Australia.

Tropidoderus Gray, 1835:31.

Type-species *Trigonoderus childrenii* Gray, [*Tropidoderus childrenii* (Gray) Gray]. *Trigonoderus* is a preoccupied name. Distribution: Australia.

SUBORDER AREOLATAE

FAMILY TIMEMATIDAE

Timeminae Caudell, 1903:882.

Timemidae Tinkham, 1942:72.

Timematidae, corrected family name.

The name "To timema-atos" is neuter, and the stem on which the family name must be formed is Timemat-.

Genus: *Timema* Scudder. Distribution: U.S.

Timema Scudder, 1895:30, *nomen nudum*.

Timema Scudder, 1903, in Caudell, 1903:883. Type-species *Timema californicum* Scudder, In Caudell, 1903:883, by monotypy.

Scudder (1895:30) intended to establish a genus under the name *Timema*, gave a short description of it, but included no named species. He said that there was a single species which he proposed to describe as *Timema californicum*, but he did not describe it, so the genus as of that date must be regarded as a *nomen nudum*.

FAMILY BACILLIDAE

Bacillidae Brunner, 1893:101.

KEY TO THE SUBFAMILIES OF BACILLIDAE

1. Antennae distinctly longer than anterior femora; alate or apterous.
Neither in Africa nor Mediterranean 2
- Antennae shorter than anterior femora (except *Xylica* Karsch); apterous.
Africa, Madagascar, Mediterranean Bacillinae
2. If alate or with wing rudiments, then apical areas of middle and hind tibiae each with a small spine, if entirely without wing rudiments, then apical areas of middle and hind tibiae without spines but prosternum with 2 rough warts next to each other. Southeast Asia, Philippines, New Guinea, Micronesia, Melanesia, Madagascar Heteropteryginae
- Apterous; apices of middle and hind tibiae unarmed; without double warts on prosternum. South America, Madagascar Pygrrhynchinae

Subfamily Bacillinae

Bacillinae Kirby, 1904a:327.

Bacillini Redtenbacher, 1906–1908:20.

KEY TO THE TRIBES OF BACILLINAE

1. Third segment of antennae slender or slightly depressed, never triquetrous 2
- Third segment of antennae triquetrous, elongate Antongiliini
2. Antennae elongate, filiform, basal segment depressed and laminate Xylicini
- Antennae stout, shorter than anterior femora, basal segment not laminate Bacillini

Tribe Bacillini

Bacillini Günther, 1953:552.

Genera included: *Bacillus* Audinet-Serville, *Clonopsis* Pantel, *Epibacillus* Redtenbacher, *Macynia* Stål. Distribution: Mediterranean region and South Africa.

Bacillus Latreille, 1825.

Type-species *Phasma rossia* Latreille [*Bacillus rossia* (Rossi) Latreille], by monotypy. Kirby's statement (1904a:333) that the type is *Bacillus redtenbacheri* Padewieth is clearly a misprint. Distribution: South Europe, North Africa.

TRIBE ANTONGILIINI

Antongiliini Günther, 1953:553.

Genera included: *Antongilia* Redtenbacher, *Cirisia* Redtenbacher, *Leprodes* Redtenbacher, *Onogastriis* Redtenbacher, *Phalces* Stål, *Pseudodatames* Redtenbacher. Distribution: Madagascar, Africa.

Antongilia Redtenbacher, 1906-1908:24.

Type-species *Antongilia laciniata* Redtenbacher, by present designation. Distribution: Madagascar.

Tribe Xylicini

Xylicini Günther, 1953:553.

Genera included: *Batycharax* Kirby, *Ocnobius* Redtenbacher, *Xylica* Karsch.

Xylica Karsch, 1898:382.

Type-species *Xylica oedematosa* Karsch, by monotypy. Distribution: Eastern Africa.

Subfamily Pygirhynchinae

Pygirhynchini Redtenbacher, 1906-1908:57.

Pygirrhyrchinae Günther, 1953:552.

Genera included: *Acanthoclona* Stål, *Canuleius* Stål, *Ceroys* Audinet-Serville, *Leiophasma* (n.n. for *Orobia* Stål), *Miroceroyis* Toledo Piza, *Miropasma* Redtenbacher, *Pachyphloea* Redtenbacher, *Parorobia* Chopard, *Pygirhynchus* Audinet-Serville, *Setosa* Redtenbacher. Distribution: Central and South America.

Kirby (1904a) separated *Ceroys* widely from *Pygirhynchus*; Redtenbacher (1906-1908:57) placed them as adjoining genera of Pygrihynchini. The genera are closely related and if they are ever synonymized, *Ceroys* has precedence and the subfamily name will have to be changed accordingly.

Pygirhynchus Audinet-Serville, 1839:260.

Type-species *Pygirhynchus subfoliatus* Audinet-Serville, by designation of Kirby, 1904a:408. Distribution: Mexico, Brazil.

Ceroys Audinet-Serville, 1839:262.

Type-species *Cladomorphus perfoliatus* Gray [*Ceroys perfoliatus* (Gray) Rehn], by designation of Rehn, 1904a:48. Distribution: Mexico to Colombia.

Subfamily Heteropteryginae

Rehn and Rehn (1939) dealing only with the Philippine forms, used the subfamily name Obriminae in the sense that we here use Heteropteryginae. It is not clear why they adopted that name which originated with Brunner, 1915, instead of using Heteropteryginae Rehn, 1904a. They stated that the Obriminae consist of a well-differentiated group which seems to be confined to the Indo-Malayan region and that it is composed of two well-differentiated tribes, the Obrimini and the Datamini, the latter being practically limited to the Philippines. We have no reason to believe that they would exclude the Anisacanthini and Heteropterygini, which do not occur in the Philippines, if they were dealing with a broader fauna.

Heteropteryginae Rehn, 1904a:89; Kirby, 1904a:401, Karny, 1923:234; Günther, 1953:546,551.

Heteropterygini Redtenbacher, 1906-1908:162.

Obriminae Rehn and Rehn, 1939:400.

KEY TO THE TRIBES OF HETEROPTERYGINAE

1. Apex of tibiae unarmed; supra-anal lamina of female wanting or not separated from 10th abdominal segment 3
- Apex of tibiae armed with spine (except *Heterocopus* Redtenbacher and *Tisamenes* Stål); supra-anal lamina of female obvious and clearly separated from 10th abdominal segment 2
2. Reduced elytra and wings distinct and large Heteropterygini
- No wing-rudiments Obrimini
3. Supra-anal lamina of female not separated from 10th abdominal segment, reduced elytra and wings distinct and large Anisacanthini
- Apical area of tibiae without spines; supra-anal lamina of female wanting, basal antennae segments without teeth (exception *Epidares* Redtenbacher) Datamini

Tribe Datamini

Obrimini Redtenbacher, 1906-1908:38.

Datamini Rehn and Rehn, 1939:405; Günther, 1953:552.

Genera included: *Dares* Stål, *Datames* Stål, *Epidares* Redtenbacher, *Orestes* Redtenbacher, *Planispectrum* Rehn, *Platyphasma* Uvarov (= *Platymorpha* Redtenbacher), *Pygocmenes* Stål, *Woodlarkia* Günther. Distribution: Southeast Asia, Moluccas, Okinawa.

Datames Stål, 1875b: 51,93.

Type-species *Acanthoderus oileus* Westwood [*Datames oileus* (Westwood) Stål], by designation of Rehn, 1904a:89. Distribution: Southeast Asia to Okinawa.

Tribe Anisacanthini

Heteropterygini Redtenbacher, 1906-1908:162.

Anisacanthini Günther, 1953:552.

Genera included: *Anisacantha* Redtenbacher, *Parcetosoma* Wood Mason. Distribution: Madagascar.

Anisacantha Redtenbacher, 1906-1908:162; Günther, 1953:55.

Type-species *Anisacantha difformis* Redtenbacher, by present designation. Distribution: Madagascar.

Tribe Obrimini

Obrimi Brunner, 1893:98.

Obriminidae Brunner, 1915:228.

Therameninae Karny, 1923:232.

Obriminini Rehn and Rehn, 1939:405.

Obrimini Günther, 1953:552.

Genera included: *Aretaon* Rehn, *Brasidas* Rehn and Rehn, *Eubrimus* Rehn and Rehn, *Eubulides* Stål, *Heterocopus* Redtenbacher, *Hoplocloonia* Stål, *Ilocano* Rehn and Rehn, *Mearnsiana* Rehn and Rehn, *Obrimus* Stål, *Pterobrimus* Redtenbacher, *Stenobrimus* Redtenbacher, *Theramenes* Stål, *Tisamenes* Stal. Distribution: Borneo, New Guinea, Philippines, Fiji.

Obrimus Stål, 1875b:49,92.

Type-species *Acanthoderus bufo* Westwood (*Obrimus bufo* Westwood), by designation of Kirby, 1904a:398. Distribution: Philippines.

Theramenes Stål 1875b:46.

Type-species *Eurycantha olivacea* Westwood [*Theramenes olivaceus* (Westwood) Rehn and Rehn], by monotypy. Distribution: Philippines.

Tribe Heteropterygini

Heteropteryginae Kirby, 1896:472.

Heteropterygini Günther, 1953:551.

Genera included: *Haaniella* Kirby (= *Heteropteryx* de Haan, not Gray), *Heteropteryx* Gray (= *Leocrates* Stål), *Miroceramia* Günther. Distribution: Borneo, Sumatra, Java.

Heteropteryx Gray, 1835:13,32; Günther, 1953:551.

Leocrates Stål, 1875b:48.

Type-species of *Heteropteryx*: *Phasma dilatata* Parkinson (*Heteropteryx dilatata* Gray), by monotypy. Type-species of *Leocrates*: *Cyphocrania graciosa* Westwood [*Heteropteryx dilatatum* (Parkinson)]. Distribution: Southeast Asia to Java.

FAMILY PSEUDOPHASMATIDAE

Phasmidae of early authors, Brunner, 1893:80; Essig 1942:118,120.

Pseudophasminae Rehn, 1904a:91; Kirby, 1904a:408; Günther, 1953:545.

Phasmata Redtenbacher, 1906–1908:117.

Pseudophasmatidae, corrected spelling.

KEY TO THE SUBFAMILIES OF PSEUDOPHASMATIDAE

1. Claws finely pectinate; elytra, if present, filiform or awl-shaped.
Orient Aschiphasmatinae
- Claws not finely pectinate 2
2. Femora indistinctly 4-carinate, without inferior median carina and unarmed; anterior femora not compressed at base; ocelli wanting; antennae fine, as long as body, indistinctly segmented. Borneo Korinninae
- If femora as described above, then ocelli are present or insects are apterous; otherwise femora with distinctly marked or toothed middle carina, or anterior femora strongly compressed, especially at base; with or without flight organs. America, Madagascar, 1 genus from Borneo
..... Pseudophasmatinae

Subfamily Aschiphasmatinae

Aschipsmidae Brunner, 1893:100.

Aschiphasminae Kirby, 1896:475.

Aschipsminae Kirby, 1904a:418.

Ascepasmini Redtenbacher, 1906–1908:73.

Aschiphasmatinae, corrected spelling.

Genera included: *Abrosoma* Redtenbacher, *Aschiphasma* Westwood, *Dinophasma* Uvarov (= *Dina* Redtenbacher), *Orthomeria* Kirby, *Parabrosoma* Giglio-Tos, *Presbistus* Kirby (= *Aschiphasma* Brunner, not Westwood). Distribution: India, Southeast Asia to Java.

Aschiphasma Westwood, 1830:442.

Ascepasma Burmeister, 1838:583, Burmeister explained the correct pronunciation of the name of this group but did not establish *Ascepasma* as a nominal genus. *Ascephasma* de Haan, 1842–1844:113. *Aschiphasma* Westwood, 1859:92. Type-species. *Aschiphasma annulipes* Westwood, by monotypy. Distribution: Southeast Asia to Philippines.

Subfamily Korinninae

Korinninae Günther, 1953:550.

Genera included: *Kalocorinnis* Günther, *Korinnis* Günther. Distribution: Borneo.

Korinnis Günther, 1932b:66.

Type-species *Korinnis potameis* Günther, by monotypy. Distribution: Borneo.

Subfamily Pseudophasmatinae

Pseudophasminae Kirby, 1896:473, 1904a:408.

Pseudophasmatinae, corrected spelling.

KEY TO THE TRIBES OF PSEUDOPHASMATINAE

1. Abdominal segments of male quadrate; of female transverse; legs unarmed; femora neither compressed nor foliaceously dilated; apterous (except *Decidia*) Anisomorphini
- Abdominal segments more elongate than in Anisomorphini, quadrate in female, longer than wide in male, or anterior femora compressed or foliaceously dilated 2
2. Middle and posterior femora with median inferior carina absent or obtuse, unarmed 5
- Middle and posterior femora with distinct inferior carina, unarmed or bluntly armed and spinulose 3
3. Elytra and wings usually obvious; posterior and middle femora occasionally with distinct superior carina; subgenital plate of male not hood like; operculum of female not produced 4
- Elytra and wings wanting; femora triangular in cross section, with 3 flat sides; subgenital plate of male hood like; operculum of female strongly produced, elongate Bacunculini
4. Elytra short, rotund-ovate; anterior femora not or slightly compressed; ocelli present Pseudophasmatini
- Elytra longer, lanceolate, rarely short; anterior femora distinctly compressed, especially toward base; ocelli variable Xerosomatini
5. Femora cylindrical or nearly so, or slightly carinate; ocelli present Stratoctleini
- Anterior femora occasionally obliquely compressed, acutely and distinctly carinate; ocelli wanting Prisopini

Tribe Bacunculini

Bacunculinae Kirby, 1896:464.

Donusae Redtenbacher, 1906–1908:98.

Bacunculini Günther, 1953:550.

Genus: *Bacunculus* Burmeister (= *Donusa* Stål). Distribution: Chile, Argentina.

Bacunculus Burmeister, 1838:566.

Donusa Stal, 1875a:7,16,18. Type-species of *Bacunculus* is *Bacteria spatulata* Burmeister [*Bacunculus spatulata* (Burmeister) Bolivar], by present selection. Kirby stated that *Prisomera phyllopus* Gray is the type-species of *Bacunculus* Burmeister. Burmeister did not include *phyllopus* but did include *Bacteria spatulata* Burmeister with which he synonymized *phyllopus* Gray with a query. Type-species of *Donusa*: *Donusa prolixa* Stål, by monotypy. Distribution: Chile.

Tribe Prisopodini²

Prisopi Brunner, 1893:100.

Prisopinae Kirby, 1904a:403.

Prisopini Günther, 1953:550.

Genera included: *Dajaca* Brunner, *Damasippoides* Brancsik, *Damasippus* Stål, *Dinelytron* Gray, *Paraprisopus* Redtenbacher (= *Melophasma* Redtenbacher), *Periphloea* Redtenbacher, *Phacophasma* Redtenbacher, *Prisopus* Latreille, *Pseudoleosthenes* Redtenbacher, *Xeranthrix* Brancsik. Distribution: Central and South America.

Prisopus Latreille, Lepeletier de Saint-Fargeau, Audinet-Serville, Guérin, 1825: 444.

Type-species *Mantis sacrata* Olivier [*Prisopus sacrata* (Olivier) Kirby], by designation of Kirby, 1904a:405. Distribution: Central and South America.

Tribe Xerosomatini

Xerosomata Brunner, 1893:99.

Sectio *Prexaspes* Redtenbacher, 1906–1908:127, not a tribal name.

Prexaspeini Günther, 1953:550.

Xerosomatini, tribal form of name.

Genera included: *Acanthometriotes* Hebard, *Creoxylus* Audinet-Serville, *Harpuna* Redtenbacher, *Isagoras* Stål, *Metriophasma* Uvarov (= *Metriotes* Westwood), *Olinta* Redtenbacher, *Planudes* Stål, *Periodes* Redtenbacher, *Prexaspes* Stal, *Xera* Redtenbacher, *Xeropsis* Redtenbacher, *Xerosoma* Audinet-Serville. Distribution: Tropical South America.

Xerosoma Audinet-Serville, 1831:61.

Type-species *Xerosoma canaliculatum* Audinet-Serville, by monotypy. Distribution: Costa Rica, Brazil.

Planudes Stål, 1875b:59,98.

Type-species *Planudes perillus* Stal by designation of Rehn, 1904a:99. Distribution: Costa Rica, Colombia, Venezuela, Brazil.

Creoxylus Audinet-Serville 1839:265.

Type-species *Creoxylus corniger* Audinet-Serville, by monotypy. Distribution: Costa Rica, Cuba, Trinidad, Colombia, British Guiana.

Metriophasma Uvarov, 1940:112.

Type-species *Metriotes diocles* Westwood, by designation of Rehn, 1904a:105. *Metriotes* an occupied name. Distribution: French Guiana, Brazil, Colombia, Ecuador, Surinam.

² Audinet-Serville gave the derivation of *Prisopus* as "*prizō*, je scie, *pous* pied." Therefore, on grammatical principles, the family-group names based upon *Prisopus* should be formed with the stem *prisopod-*, giving Prisopodini, etc.—Ed. note (G. C. Steyskal).

Tribe Pseudophasmatini

Phasmata Brunner, 1893:99.

Pseudophasmini Günther, 1953:550.

Pseudophasmatini, corrected spelling.

Genera included: *Ignacia* Rehn, *Pseudophasma* Kirby. Distribution: Cuba, South America.

Pseudophasma Kirby, 1896:473.

Type-species *Gryllus necydaloides* L. = *Gryllus plithisicus* L. [*Pseudophasma plithisicum* (L.) Kirby, = *Gryllus brachypterus* Linné, *Phasma bioculatum* Stoll,

Phasma castaneum Bates.], by monotypy. (For priority of *Pseudophasma* Bolivar vs. *Pseudophasma* Kirby, see Rehn, 1904:95, footnote.) Distribution: Cuba, South America.

Ignacia Rehn, 1904a:95.

= *Pseudophasma* Bolivar var. not Kirby, = *Pseudophasma* Bolivar, 1896:12. Type-species *Pseudophasma auriculatum* Bolivar, by monotypy. Distribution: Amazon basin.

Tribe Stratoctleini

Section *Stratoctles* Redtenbacher, 1906–1908:100, not a tribal name.

Stratoctlinae Brunner, 1915:202.

Stratoctleini Günther, 1953:550.

Genera included: *Agrostia* Redtenbacher, *Anisa* Redtenbacher, *Antherice* Redtenbacher, *Brachyelena* Hebard, *Brizoides* Redtenbacher, *Chlorophasma* Redtenbacher, *Citrina* Redtenbacher, *Holca* Redtenbacher, *Holcoides* Hebard, *Olcypoides* Griffini, *Paraphasma* Redtenbacher, *Parastratoctles* Redtenbacher, *Tenerella* Redtenbacher, *Stratoctles* Stål. Distribution: Amazon basin.

Stratoctles Stål, 1875b:57,96.

Type-species *Stratoctles cinctipes* Stål, by monotypy. Distribution: Central and South America.

Tribe Anisomorphini

Anisomorpha Brunner, 1893:98.

Anisomorphini Redtenbacher (in part), 1906–1908:87.

Genera included: *Agathemera* Stål, *Anisomorpha* Gray (= *Malacomorpha* Rehn, *Allocoptasma* Redtenbacher), *Autolyca* Stål, *Decidia* Stål, *Paranisomorpha* Redtenbacher, *Pseudolcypoides* Karny (= *Olcypoides* Redtenbacher, not Griffini). Distribution: U.S. to Chile.

Anisomorpha Gray, 1835:13,18.

Malacomorpha Rehn, 1906:13. *Allocoptasma* Redtenbacher, 1908:126. Type-species *Phasma buprestoides* Stoll [*Anisomorpha buprestoides* (Stoll) Gray]. Distribution: America.

FAMILY PHYLLIIDAE

Phyllidae Brunner, 1893:101.

Phyllinae Rehn, 1904:105.

Phylliinae Kirby, 1904a:420.

Genera included: *Chitoniscus* Stål, *Nanophyllum* Redtenbacher, *Phyllum* Illiger. Distribution: Southeast Asia to New Guinea, Seychelles and Solomon Islands.

Phyllum Illiger, 1798:499.

Type-species *Gryllus siccifolius* L. [*Phyllum siccifolium* (F.) Illiger], by designation of Rehn, 1904a:105). Distribution: Southeast Asia to New Guinea to the Seychelles.

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⁴ Jean Guillaume Audinet Serville has been referred to by nearly all authors as 'Serville'; this is incorrect. In 1831 he published his name with a hyphen, 'Audinet-Serville', as author of his work.

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COLASPIS FAVOSA SAY AND ITS CLOSE RELATIVES
(COLEOPTERA: CHRYSOMELIDAE)

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ABSTRACT—Descriptions are given for *Colaspis favosa* Say and the new species *C. cruriflava*, *C. floridana*, *C. sanguinea*, *C. similis*, and *C. suggona*.

Colaspis favosa Say

Fig. 1, 3

Colaspis favosa Say, Journ. Acad. Phil. III, 1827, p. 441.

Colaspis favosa Crotch, Proc. Acad. Phil. XXV, 1873, p. 44.

Colaspis favosa Horn, Trans. Am. Ent. Soc., XIX, 1892, p. 223-5.

Say in his description of *C. favosa* wrote that "it inhabits Arkansas". In the collection of the United States National Museum, H. S. Barber has dissected many specimens of the dark blue green U.S. species of *Colaspis* that have gone under the name of *C. favosa*, and he has labelled two specimens "*Colaspis favosa*", one from Ardmore, Indian Territory (Oklahoma) and the second from Woods Co., Oklahoma. He has also written on one "type locality, Arkansas". He identified them as *favosa* undoubtedly because they are or were the only ones coming from the nearest Arkansas that he found in the collection. We have little left of the Say collection and cannot know what species he was describing in this group of blue green beetles. But I have found one male specimen in the collection of blue green beetles that comes from Hot Springs, Arkansas, and it is not the same as the Oklahoma ones.

These dark blue green beetles, sometimes nearly black, sometimes with a bronzy lustre, have all gone under the name of *C. favosa* Say. The group is analogous to the costate yellow brown closely related species of the *C. brunnea* group in the U.S., and like that group only by close examination and study can one differentiate them. But there are very definite differences in size, shape, in punctuation, and above all in the genitalia. When one makes drawings of them these differences become at once apparent. So, taking the one specimen from Hot Springs, Arkansas as the true *favosa*, I am describing it as follows:

Length 4.5-6 mm. Width 2.4-3.4 mm. Elongate oblong oval, shiny, blue green, blue or even with a bronzy lustre, with dark reddish-brown legs and antennae except the 3 terminal joints which are more or less dark, body beneath

with prosternum and mesosternum green or blue green, abdomen brown, sometimes with a green lustre, upper surface densely punctate.

Head with interocular space more than $\frac{1}{2}$ width of head, densely punctate throughout, labrum brown. Antennae with terminal joints dark. Prothorax not $2\times$ as wide as long, densely punctate, sides rounded with little trace of angularity or toothing. Scutellum dark and polished. Elytra approximately $3\times$ as long as prothorax and a little wider, densely, almost confluent punctate with punctures near suture, margin and apex in single lines, elsewhere irregularly geminate, everywhere coarser than on prothorax. Body beneath with dense punctures on prosternum, fine, inconspicuous punctures on mesosternum, both prosternum and mesosternum dark green or blue, abdomen dark brown to piceous.

Type: Probably not in existence.

Type-locality: Arkansas.

Other Collections: Washington, D.C.: Oxon Run, R. C. Shannon; 4-mile Run, Bridwell. Virginia: Bluemont, G. M. Greene; Richmond, C. T. French; Colonial Beach; Glen Carlyn, W. L. McAtee; Arlington, D. H. Blake, on alder; Plummer's Island, F. Knab; North Carolina: Morehead City, Havelock; Wickham; Tryon, W. F. Fisher; Chadbourne. South Carolina: Charleston; Florence, W. N. Kirk. Georgia: Sea Island, Nashville, Jasper, W. F. Turner; Atlanta, G. M. Greene; Blue Ridge, E. M. Jordan. Alabama: Mobile, G. M. Greene; H. F. Loding; Seminole, F. G. Werner. Louisiana: Covington, H. Soltau; Hammond, C. E. Smith; Mandeville, H. Soltau. Mississippi: Waveland, H. Soltau; Starkeville, C. E. Hunt; Arkansas: Hot Springs, Fred Knab.

Remarks: This species is widespread in the southeast and occurs along the eastern coast states from Georgia to Virginia and west along the Gulf through Alabama, Mississippi to Louisiana and Arkansas. It is smaller than *C. suggona*, the species in the Central States, and the one on Long Island, which I am describing as *C. similis* n.sp. It is close to *C. floridana*, the species from Florida; the aedeagus being similar but with a longer point than in *C. floridana*. There is considerable variation in size and I have made drawings of 2 males to illustrate this. The males are usually smaller than the females, and my first drawing (Fig. 1) is of a small male, which shows how even the males vary in size. My second drawing of *C. favosa* (Fig. 3) is of a large male.

Colaspis floridana Blake, NEW SPECIES

Fig. 2

Length 5-5.5 mm. Width 2.2-2.6 mm. Elongate oblong oval, shiny dark green sometimes with a bronzy or even rosy lustre; antennae pale reddish brown with terminal 3 joints dark, labrum brown, legs black, sometimes tibiae at base paler, body beneath dark, often with a green lustre.

Head with interocular space a little more than $\frac{1}{2}$ width of head, densely, finely punctate throughout with dark brown labrum and mouthparts, a median line down front, very finely and densely punctate. Antennae pale reddish brown,

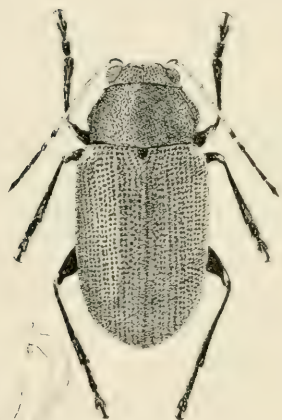
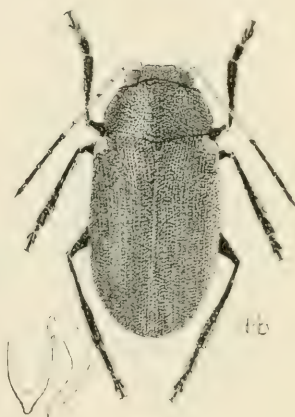
1. *Colaspis favosa* Say2. *C. floridana* n.sp.3. *C. favosa* Say4. *C. sanguinea* n.sp.

Fig. 1, 3. *Colaspis favosa*. Fig. 2. *C. floridana*. Fig. 4. *C. sanguinea*.

last 2 or 3 joints dark. Prothorax nearly $2\times$ as wide as long, a more or less distinct angularity on sides below middle, some specimens more rounded, disc very finely and densely punctate, punctures tending to be oblong. Scutellum dark green or bronzy. Elytra approximately $3\times$ as long as prothorax with punctures in single lines near suture, margin and apex, irregularly punctate elsewhere. Body beneath with punctures on prosternum which is usually green, mesosternum green in middle, black on sides, abdomen dark usually with a green lustre; legs dark brown to black, sometimes tibiae with reddish brown streaks.

Type: ♂, USNM Type No. 73480.

Type-locality: West Palm Beach, Florida, on okra.

Other Collections: Florida: St. Petersburg, Van Duzee; Baldwin, Barber and Schwarz; Tampa, on gaura; Orlando, on pecan; Haw Creek; Gainesville, J. S. Rogers; Wyaka, V. M. Kirk.

Remarks: This species resembles *C. favosa* in shape, but the head and prothorax are more finely punctate and the elytra are not so densely punctate as in *C. favosa*. The aedeagus has a shorter point than that of *C. favosa*.

Many specimens have a bronzy or rosy lustre, while others are entirely green above.

Colaspis similis Blake, NEW SPECIES

Fig. 7

Length 6–6.5 mm. Width 3–3.4 mm. Oblong oval shiny dark green or blue green with dark brown to piceous legs, antenna with basal joints pale, terminal 2 or 3 joints dark. Head and prothorax densely and finely punctate, elytra more coarsely punctate.

Head with interocular space more than $\frac{1}{2}$ width of head, densely punctate over front and clypeus, labrum dark brown. Antennae pale reddish brown with terminal 2 or 3 joints dark. Prothorax approximately $2\times$ as wide as long with margin faintly angulate below middle, disc finely and very densely punctate. Scutellum polished dark green. Elytra more than $3\times$ as long as prothorax and wider with coarse punctuation, in single lines near suture, margin and apex, irregularly geminate elsewhere, a trace of costae between rows of punctures, on sides and at apex. Body beneath dark green on prosternum and mesosternum, dark reddish brown to piceous on abdomen, prosternum punctate.

Type: ♂, and 1 ♀ paratype, USNM Type No. 73481.

Type-locality: "S. I." (Staten Island, N. Y.) Bridwell, collector.

Other Collections: Long Island, N. Y., Schaeffer collection.

Remarks: There are only 3 specimens of this species in the collection, and all are from around New York City. While in general resembling the other species of the group, *C. similis* has the aedeagus broader near the tip than in the other species.

Colaspis suggona Blake, NEW SPECIES

Fig. 5

Length 5.5–7 mm. Width 2.8–4 mm. Elongate oblong oval, shiny, varying in color from blue green to blue black with dark brown labrum and basal joints 2–6 of antennae reddish brown, finely and densely punctate over head and prothorax and more coarsely punctate elytra.

Head with interocular space more than $\frac{1}{2}$ width of head, front with a slight

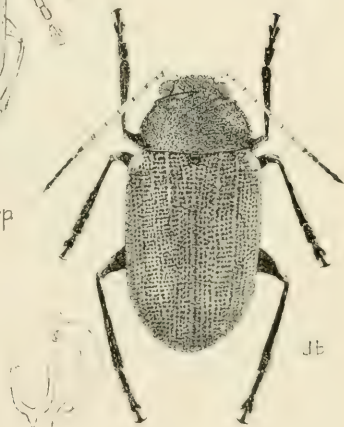
5. *Colaspis suggona* n.sp.6. *C. cruriflava* n.sp.7. *C. similis* n.sp.

Fig. 5. *Colaspis suggona*. Fig. 6. *C. cruriflava*. Fig. 7. *C. similis*.

median depression, very finely and densely punctate throughout. Antennae with basal joint dark, joints 2-6 reddish brown, remainder dark. Prothorax not quite $2\times$ as wide as long, lateral margin sinuate, verging on dentate below middle, disc very finely and densely punctate. Elytra $3\times$ as long as prothorax with a densely and coarsely punctate surface, punctures tending to be in geminate rows but not always, remnants of costae at apex and along sides, in some specimens traces of costae near base also. Body beneath dark, prosternum finely punctate on sides. Legs dark.

Type: ♂, and 7 paratypes, USNM Type No. 73482.

Type-locality: Texas, Charles Schaeffer collection.

Other Collections: Kansas: Topeka, popenoe collection; Onaga, F. F. Crevecoeur collections; Douglas Co., Snow; Mitchell Co., Schwarz; Mt. Hope, George Greene; Baldwin, Moznette; Ottawa, E. S. Titus. Iowa: Muscaline, Buchanan; Ames, G. O. Hendrickson. Illinois: Chicago. S. Dakota: Wickham; Volga, Truman. Nebraska: Sandhills; Crete; West Point. Colorado.

Remarks: This species is variable in color, some specimens being green, others deep dark blue green, others green with a bronzy lustre, and still others dark bluish purple, almost black. There are 5 specimens from Aransas, Texas, which are dark bronzy brown, one of these with a faint green lustre. H. S. Barber has labelled them "var." The aedeagus is the same shape as the rest. This is one of the larger species of the *favosa* group, although varying in size too. This species is widespread through the central states from Texas through Kansas and north to northern Illinois and South Dakota, Nebraska, Iowa, and Colorado.

Colaspis sanguinea Blake, NEW SPECIES

Fig. 4

Length 5.7–7 mm. Width 3–3.4 mm. Elongate oblong oval, shiny blue green with yellow-brown antennae except the 1st and 5 terminal joints which are dark, labrum pale brown, below with dark brown legs, green body and brown abdomen. Densely and rather finely punctate.

Head with interocular space more than $\frac{1}{2}$ width of head, very finely and densely punctate throughout. Labrum pale brown. Antennae with basal and 5 terminal joints dark. Prothorax nearly $2\times$ as wide as long, with rounded sides in which the majority show little sign of angularity or tooting. Surface densely and very finely punctate. Scutellum shiny dark green. Elytra more than $3\times$ as long as the prothorax and wider, very densely and rather finely punctate, punctures in single lines near margin and suture, irregularly geminate punctate elsewhere. Body beneath with punctures on prosternum and mesosternum, dark green prosternum and mesosternum, abdomen dark brown.

Type: ♂, USNM Type No. 73483.

Type-locality: Ardmore, Indian Territory (Oklahoma), C. R. Jones collector.

Other Collections: Oklahoma: So. McAlester, Wickham; Vinita, June 7–8, Wickham; Bartlesville, A. C. Caudell; Woods County, Sept. 7, 1930, R. D. Bird.

Remarks: This species differs from the rest of the group in having proportionately longer elytra: the elytra being considerably longer than three times as long as the prothorax. Besides this, the elytra are unusually finely punctate, more so than in the others. The aedeagus differs from the rest in being wider near the tip.

Colaspis cruriflava Blake, NEW SPECIES

Fig. 6

Length 4-4.5 mm. Width 2.3-2.5 mm. Elongate oblong oval, shiny green with yellow-brown legs, labrum, and basal joints of antennae, densely punctate on prothorax and elytra, a slanting depression on either side of prothorax near base.

Head with interocular space more than half width of head, front smooth, nearly impunctate except above frontal tubercles where very fine punctures occur. Antennae pale yellow brown with apical four joints dark. Prothorax not much wider than long with faint angularity below middle on side margins, surface densely and finely punctate; on each side near base a slanting depression. Scutellum polished green. Elytra not quite 3 times as long as prothorax and somewhat wider, densely punctate throughout, in single lines near suture, base and margin, in more or less geminate lines in middle of elytra. Body beneath with abdomen dark, prosternum and mesosternum green, prosternum punctate. Legs yellow brown with claw dark brown.

Type: And 2 paratypes USNM Type No. 73484.

Type-locality: Canelo, Arizona, G. D. Butler, Aug. 3, 1956.

Remarks: This species is somewhat paler green than the rest and the only one of the group with yellow legs. It is the smallest one of the *favosa* group. There is a peculiar depression on each side of the prothorax not found in the others, and the aedeagus is quite different from the others. In fact, it hardly fits into the group.

NOTES ON THE ANTS OF LUQUILLO FOREST, PUERTO RICO
(HYMENOPTERA: FORMICIDAE)^{1,2}

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ABSTRACT—Distribution records and ecological notes are presented for 34 species of ants found in Luquillo Forest, Puerto Rico. Feeding on ants by lizards of the genus *Anolis* and frogs of the genera *Eleutherodactylus* and *Leptodactylus* is recorded.

In the process of examining the stomach contents of frogs occurring in the Luquillo Experimental Forest in northeast Puerto Rico, I encountered the remains of several different species of ants. Upon examining the literature, I found that while most of the island had been fairly extensively surveyed for ants, none of the previous investigators had had the opportunity of penetrating the tropical wet forest. Wheeler (1908) obtained sufficient material in a month to describe several new species and to provide ecological data. A single species was described by Mann (1920) and more were added to our taxonomic knowledge of the ants of the island by Wheeler (1934). After spending a year gathering ecological data on the ants of the western half of the island, Smith (1936) summarized the available information and described one new species. Mention of only two species, *Camponotus ustus* Forel and *Myrmelachista ramulorum* Wheeler, was made by Martorell (1945) in his two volume work on Puerto Rican forest insects. Wolcott (1948) summarized the information provided by the previous investigators, emphasizing the importance of ants in the diets of *Anolis* lizards. A partial list of the ants occurring in the vicinity of El Verde Field Station, Luquillo Forest was prepared by Drewry (1970) as part of a list of insects of that forest. During the course of the work herein reported, Smith and Lavigne (1973) described a new species of *Paratrechina* from Luquillo Forest as well as a new species of *Tapinoma* from Maricao Forest.

Luquillo Experimental Forest is a tropical montane forest with an annual rainfall of between 279 and 330 cm. Elevations within the forest vary from approximately 400 m at the lowest elevation to 1065 m on El Yunque Peak. The terrain near El Verde Field Station (elev. 455 m) in the tabonuco forest, where the majority of observa-

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² Partial support and laboratory facilities were provided by the Terrestrial Ecology Division, Puerto Rico Nuclear Center, San Juan, Puerto Rico.

tions were made, consists of numerous fingerlike ridges, with small valleys between. As many as 256 different species of plants may occur in a single acre. Trees are tall and the upper story canopy may reach a height of 25 m. Litter decomposition is rapid and litter buildup is minimal resulting in a very shallow layer of debris except in depression type situations. The soil in the area contains a high proportion of clay and soil water infiltrates almost vertically, although when it reaches denser soil it flows downslope. As would be expected, well-drained soil occurs on the top of the ridges and poorly drained at the bottom (Puerto Rico Nuclear Center Ann. Rept. 119; Personal communication with Dr. George Drewry).

Four vegetation zones have been described for Luquillo Forest. Beginning with the highest elevations they are (1) the mossy forest, in which the trees rarely exceed 5 m and are covered with hanging moss, (2) the palm forest, (3) the Colorado forest, in which the dominant species is *Cyrtilla racemiflora* L. and (4) the tabonuco forest, where the dominant tree is *Dacryodes excelsa* Vahl. Only five species of ants were found in the mossy forest: *Strumigenys rogeri* Emery, *Paratrechina* sp. near *vividula* (Nylander), *Iridomyrmex melleus* Wheeler, *Hypoponera ergatandria* (Forel), and *Trachymesopus stigma* (Fabricius). With the exception of *Hypoponera ergatandria*, these ant species occur throughout the forest. Nine additional species appear in the palm forest (elev. 793 m–915 m): *Anochetus mayri* Emery, *Strumigenys gundlachi* (Roger), *Myrmelachista ramulorum*, *Brachymyrmex heeri* Forel, *Paratrechina steinheili* (Forel), *Macromischa isabellae* Wheeler, *Solenopsis azteca pallida* Wheeler, *S. corticalis* Forel, and *S. geminata* (Fabricius). The Colorado forest was not extensively penetrated but is believed to contain all the forest species listed except for possibly *Hypoponera ergatandria*. All species, except *H. ergatandria* were collected within the tabonuco forest. More extensive collecting should show that *H. ergatandria* occurs in other parts of the forest unless it arrived in the mossy forest transported by air currents or automobiles.

Distribution data for the ant species were obtained by three methods (a) observation, (b) dissection of frog stomachs, and (c) establishment of tunafish bait stations.

Observations on the habits of ants were conducted from the end of November, 1969, to the end of August, 1970, incidental to the main project of determining the feeding habits of frogs in relation to niche diversity. Frogs were collected in the forest at all hours of the night and immediately after capture were injected with Turttox Insect Preservative, using a hypodermic syringe. Injected into the stomachs, the preservative acted to halt the action of stomach acids. Frogs

were identified either in the field or immediately upon returning to the laboratory. They were then stored in Turttox Insect Preservative until such time as the digestive tracts could be removed and opened. The few lizards collected during the daylight hours were treated in the same fashion.

With the exception of *Leptodactylus albilabris* (Guenther), all the frogs collected belonged to the genus *Eleutherodactylus* and were *coqui* Thomas, *antillensis* (Rheinhard and Leutken), *brittoni* Schmidt, *portoricensis* Schmidt, *richmondi* Stejneger, *hedricki* Rivero, *eneidae* Rivero, *wightmannae* Schmidt, *locustus* Schmidt, *gryllus* Schmidt, *karlschmidti* Grant, *unicolor* Stejneger, *cooki* Grant and *cochranae* Grant. *Eleutherodactylus cooki* is restricted to the Panduras mountain range of southeastern Puerto Rico and *E. cochranae* is restricted to the coastal plains. The lizards dissected all belong to the genus *Anolis* and were *evermanni* Stejneger, *stratulus* Cope, *gundlachi* Peters, and *krugii* Peters.

The species of ants which were subjected to the most intense predation by *Eleutherodactylus* frogs in Luquillo Forest were *Pheidole moerens* Wheeler, *Wasmannia auropunctata* (Roger) and *Iridomyrmex melleus* Wheeler. It is probable that these species are the most abundant ants in the vicinity of El Verde Field Station. General observations support this contention.

In order to ascertain that all scavenger ants in the vicinity of El Verde Field Station had been discovered and to attempt to assign activity periods to certain species, a series of 22 stations was established along a forest trail at 8 am on August 11, 1970. These stations were baited with tunafish and hourly counts of ants were made at the stations over the following 24 hours. The bait was replaced as needed. There was some indication that some species were able to force other species to relinquish their positions at individual bait stations. For example, in one case *Pheidole moerens* workers disappeared from the bait at the same hour that *Paratrechina cisipa* Smith and Lavigne workers began to appear in numbers. In three other cases, upon the appearance of *Paratrechina microps* (Smith) workers, the *P. moerens* workers disappeared, whereas at station 6 where no *Paratrechina* species appeared, *P. moerens* workers were active all night. The *P. moerens* workers would then appear in the morning at whatever time the nocturnal species disappeared. At one station, it was observed that *Iridomyrmex melleus* workers maintained a position on the perimeter of the bait station while *Solenopsis corticalis* workers were feeding on the bait, and at another these *corticalis* workers were observed "fending off" *Pheidole flavens sculptior* workers. At two other stations *Solenopsis azteca* workers were "holding off" a ring of *Wasmannia auropunctata* workers. Experiments

should be conducted to establish this tendency of forest ants to compete for available food.

Based on general observation and data obtained from the bait stations, it appears that all the forest Formicinae, with the possible exception of *Myrmelachista ramulorum* and *Paratrechina steinheili*, are nocturnal. Among the Dolichoderinae, only *Tapinoma litorale* Wheeler and among the Myrmicinae, only *Pheidole flavens sculptior* Forel, appear to be primarily nocturnal. All members of the forest Ponerinae forage singly in the litter, and although *Odontomachus* sp. and *Hypoponera ergatandria* were taken at tunafish bait only at night, the observations made are insufficient to establish a trend.

MYRMICINAE

Strumigenys eggersi Emery: The only specimens of *S. eggersi* collected by the author in Luquillo Forest were dissected from the stomachs of four juvenile frogs (*Eleutherodactylus portoricensis*) collected near El Verde Field Station, but Drewry (1970) had previously listed it from this locale, taken on sticky traps in the forest.

Strumigenys rogeri Emery: This species occurs commonly in the lower reaches of Luquillo Forest. Workers were also dissected from the stomachs of *Eleutherodactylus locustus* males, females and juveniles collected in the mossy forest on the slopes of El Yunque Peak (elev. 1000 m). No specimens of any species of *Strumigenys* were taken at tunafish bait stations. Workers of *S. rogeri* were only observed foraging at night and, even then, deep within the litter. On two occasions, several workers were collected from inside the dehiscend seed coats of *Guarea trichilioides* L.

Three colonies were located and were all nesting within individual decaying *Cecropia peltata* L. pith chambers lying in the forest litter. The colony collected on November 16 contained 1 queen, 2 eggs, 12 larvae, 2 pupae, 105 workers and 2 winged reproductives. That on December 11 contained 3 queens, 1 egg, 14 larvae, 3 pupae and 8 workers (one newly emerged). The colony collected on March 24th contained 2 queens, 18 eggs, 29 larvae, 20 pupae and 53 workers. In this latter colony was also a large female lacking wing scars. One side of this latter chamber contained a "trash" pile of insect parts. Two coccids were also found in this chamber.

Based on the number of amphibians consuming this ant, it would appear that *Strumigenys rogeri* is fairly well distributed in Luquillo Forest occurring at all elevations. Workers were collected from the stomachs of the lizards *Anolis gundlachi*, *A. krugii* and the frogs, *Eleutherodactylus coqui*, *E. portoricensis*, *E. richmondi*, *E. wightmannae*, *E. eneidae*, *E. brittoni* and *E. locustus*.

Additionally, workers were found in the stomachs of *E. cochraniae*

females and *E. coqui* juveniles collected in a wet pasture 2 miles east of Rio Grande, near the coast.

Strumigenys gundlachi (Roger): I did not encounter foraging workers of this ant species in Luquillo Forest but specimens were dissected from the stomachs of *Eleutherodactylus coqui*, *E. portoricensis*, *E. richmondi*, *E. wightmannae* and *E. eneidae* collected at lower elevations in the forest. Workers were also found in the stomachs of some juvenile *E. brittoni* collected in the Palm forest on El Yunque (elev. 755 m). Workers of *Strumigenys gundlachi* were also collected from the litter in Maricao Forest.

Cyphomyrmex rimosus minutus Mayr: At lower elevations in Luquillo Forest, workers were occasionally observed during the daylight hours foraging in the forest litter. In one instance workers were observed "working" a decaying fruit of *Brysonima coriacea* and on another occasion a single worker was observed carrying an unidentified piece of vegetation. According to Smith (1936), their food consists of "yellowish, pear-shaped bodies of fungus", and Weber (1955) has shown that this species cultivates fungus gardens.

No colonies were discovered but on May 27, a single female winged reproductive was found, along with 17 workers, inside a decaying hollow seed in the litter of Maricao Forest (Rte 120:Km 10, H1).

Workers were collected in Luquillo Forest from the stomachs of the frogs, *Eleutherodactylus coqui*, *E. richmondi* and *E. antillensis*, and that of the lizard, *Anolis krugii*.

Mycocepurus smithi Forel: This fungus ant is recorded as nesting in small colonies in red clay soil, the entrance being "more or less obscured by the earth thrown over and around it" (Smith, 1936).

Nine workers were observed on the morning of December 29 in the vicinity of El Verde Field Station; they were busily engaged inside the seed coat of *Paullinia pinnata* L. decaying on the forest floor. Other than these, the only individuals seen were collected from the stomachs of frogs representing four species of *Eleutherodactylus*, namely *coqui*, *portoricensis*, *richmondi* and *wightmannae*. Frogs of the first two species were all juveniles and those of the last two species, males. These stages of these frogs forage primarily in the litter, indicating where colonies of these ants probably nest in Luquillo Forest.

Additional unpublished Puerto Rican records for this species are as follows: Near Sabana Grande (Rte 2:Km 16, H3), V-28-70, in soil; Maricao Forest (Rte 120:Km 10, H2), V-27-70, in litter on trail.

Wasmannia auropunctata (Roger): This small yellowish orange ant, commonly called the "albaya" by the natives, is one of the most common of all Puerto Rican ants found "from El Morro at San

Juan to the tops of the mountains" (Wolcott, 1948). Its sting has made the worker ant notorious and coffee plantations have been abandoned because of the natives' refusal to work in the same area as the ant. This species was common at lower elevations in Luquillo Forest.

This species is primarily diurnal as indicated by observations made over a 10 month period. At two tunafish bait stations, they were only present during the daylight hours. However, in late February, workers were observed crawling across litter at 10:15 pm and at bait site #1; workers were constantly present from 11 am one day until 9 am the following morning.

Workers have been observed carrying insect parts, whole dead insects, working decaying fruits of *Guarea trichilioides*, *Manilkara balata bidentata* (A., DC.) Cher. and *Dacryodes excelsa* Vahl. in the forest litter. In the Maricao Forest they were collected tending *Pseudococcus maritimus* (Ehrhorn) inside the hollow fruit of *Calophyllum brasiliense* Camb. in the litter.

A winged reproductive was taken from the stomach of an *Anolis krugii* female collected on March 3 in Luquillo Forest. Both male and female reproductives were found in sections of 2 nests in hollowed-out fruits of *Calophyllum brasiliense* in the forest litter on May 27, 1970, in the Maricao Forest.

In Luquillo Forest, only one populus colony of several hundred individuals was encountered located within a decaying log. In all other instances apparently only portions of colonies were discovered. The number of ants in these "cells" varied from 1,903 workers, 307 larvae and 38 pupae to 18 workers, 3 larvae and 52 pupae, but never was a queen present in these gatherings. Workers caring for larvae and pupae and occasionally eggs were often encountered in the seed pods of *Inga vera* Willd., inside the seed coat of *Dacryodes excelsa* seeds, inside the partly dehiscent seed coats of *Sloanea berteriana* Choisy and between two wet leaves in the litter. This leads me to theorize that, in the absence of suitably large quarters, this ant species is able to maintain disjoint nests with only tenuous communication with the queens.

Workers of *Wasmannia auropunctata* were found in the stomachs of the lizards, *Anolis gundlachi*, *A. krugii*, *A. stratulus* and *A. evermanni*. Additional workers were dissected from the stomachs of the frogs, *Eleutherodactylus coqui*, *richmondi*, *wightmannae*, *antillensis* and *brittoni*. The last two mentioned frogs occur in the more open areas at the forest edge.

Additional unpublished Puerto Rican records for this species are as follows: Humacao (Rte 3; Km 10, H11), V-25-70, in soil at base of bush; El Verde (Rte 186), VII-6-70, workers tending unidentified

aphids on leaves of tree shoots at the base of a breadfruit tree, *Artocarpus altilis* (Parkinson) Fosberg.

Tetramorium guineense (Fabricius): This is an introduced and tramp species, which has been found most commonly along the sea-coast in Puerto Rico.

Drewry (1970) listed it from the forest at El Verde Field Station, but I found only one specimen of this species in Luquillo Forest on the seed coat of a decaying *Dacryodes excelsa* seed lying on the soil. None were dissected from stomachs of either frogs or lizards collected in the forest.

Macromischa isabellae Wheeler: I found portions of two colonies of this brightly colored ant in Luquillo Forest; both colonies were on a forested ridge on El Yunque at an elevation of 753 meters. One colony was found April 20, 1970, within a dead hollowed-out vine of *Clusia krugiana* Urban slightly less than 1 m above the ground. The vine had a diameter of 4 cm at that height. This nest contained 19 workers, 1 winged reproductive, 15 eggs, 35 larvae, 4 worker pupae and 1 reproductive pupa; no queen was found. Additional workers were collected crawling on ferns and tree trunks. Part of another colony was located June 8, within a decaying *C. krugiana* limb at a height of 1½ m. Seventeen workers, 8 eggs, 24 larvae and 6 pupae were found in a single chamber, 16 × 7 mm. Additional workers were observed nearby crawling on ferns at a height of 1½ m. Dr. Cameron Kepler (personal communication), who was then living in a Forest Service house across the road from the ridge, informed me that he had found colonies consisting of less than 100 workers in the hollow sections of decayed *Cecropia* limbs.

The food of this ant has not been ascertained, but tunafish placed at the tip of the limb housing the second colony attracted several workers. Workers of *Macromischa isabellae* were dissected from the stomachs of *Eleutherodactylus locustus* found in the tall grass in front of Dr. Kepler's residence.

Pheidole subarmata var. *borinquenensis* Wheeler: This form appears to be rare in Luquillo Forest, although Drewry (1970) collected workers on a sticky trap in the vicinity of El Verde Field Station. A portion of only one colony was discovered, consisting of 126 workers and 3 soldiers inside a pod of *Inga vera* lying on the forest floor. The only record of predation was that of a male *Eleutherodactylus portoricensis*, whose stomach contained several workers.

An additional unpublished Puerto Rican record for this species is as follows: Beach at Ensenada Comezon, near Rio Grande, III-3-70, colony in sand.

Pheidole moerens Wheeler: In Luquillo Forest, *P. moerens* is one of the most common ants encountered up to elevations of approxi-

mately 600 m. Workers are consistently found working inside the decaying seed coats of *Dacryodes excelsa* and *Guarea trichilioides*, feeding on the fruits of *Manilkara bidentata* and *Linociera domingensis* (Lam.) Knobl. and working inside the downed seed pods of *Inga fagifolia* (L.) Willd. Steady streams of workers were found at 15 of the 20 tunafish bait stations on August 11 and thus indicate that this species is probably omnivorous.

Most observations indicate that these ants are normally diurnal. Worker activity ceased at most bait stations between 5 and 10 pm, although at one bait site, workers continued to forage throughout the night. Workers reappeared at the bait between 4 and 7 am, usually 6 am.

Portions of colonies containing workers, soldiers, larvae and pupae were found beneath rocks on trails, beneath rocks in the litter and in one instance within the decaying partly dehiscent seed coat of *Sloanea berteriana*.

On one occasion *Pheidole moerens* workers were found beneath the decaying roots of a dead *Euterpe globosa* palm in association with a termite colony.

One apparently complete colony was located in a decaying tree limb lying on the forest floor. This limb, opened on June 24, contained a single queen, several hundred larvae and pupae, several hundred workers, 55 soldiers (8 of which were callow), 32 female winged reproductives (6 of which were callow) plus 9 adult colydiid beetles. Several different chambers were used; one frass chamber contained parts of other ant species, primarily *Odontomachus* sp. and *Iridomyrmex melleus*.

Stomach dissections revealed that three species of lizard, *Anolis gundlachi*, *A. stratulus* and *A. evermanni* fed upon *Pheidole moerens* workers. These ants were also present in the stomachs of 9 species of *Eleutherodactylus*, namely *coqui*, *portoricensis*, *richmondi*, *wightmanae*, *eneidae*, *locustus*, *gryllus*, *brittoni*, and *karlschmidtii* as well as that of a female *Leptodactylus albilabris*.

Pheidole flavens sculptior Forel: In Luquillo Forest, this species appears to be primarily nocturnal, although one colony was located beneath the concrete patio in front of the laboratory, as a result of following a line of workers one morning. Workers usually began to appear on top of the forest litter at 9 pm. Hourly observations throughout one particular night revealed that their numbers increased until about 3 am and subsequently declined. By 8 am only one worker was still active.

Tunafish bait attracted workers at three sites on August 11. At one site the ants worked the bait from 11 am until 2 pm, at a second, from 8 pm until 4 am and at the third site from 1 pm until 7 am.

An apparently complete colony was found in a decaying *Cecropia peltata* limb on July 23 in the forest litter, which also housed part of a colony of *Iridomyrmex melleus*. The *Pheidole* colony was maintained in the laboratory from that date to August 13 when it was sacrificed. The colony then contained 4 larvae, 27 soldiers, 151 workers and a single queen.

Despite the rarity with which foraging workers of this species were encountered in the forest, they were frequently dissected from the stomachs of the frogs, *Eleutherodactylus coqui*, *E. portoricensis*, *E. antillensis*, *E. brittoni*, *E. locustus*, and *E. gryllus*. They were also occasionally found in the stomachs of the lizards, *Anolis gundlachi*, *A. stratulus* and *A. krugii*.

Monomorium floricola (Jerdon): This is a tramp species which was already common in Puerto Rico in the early 1900's (Wheeler, 1908). It apparently has recently invaded Luquillo Forest, since Drewry (1970) collected it on sticky traps within the forest near El Verde Field Station. I did not encounter it within the forest nor was it found in the stomachs of any of the forest frogs or lizards dissected. Neither were any taken at the bait stations. One colony had established itself inside the laboratory, but how the ants originally arrived there is unknown.

Outside the forest, workers of *M. floricola* were abundant in the stomachs of *Eleutherodactylus cochranae* and *E. coqui* collected in a wet pasture 2 miles east of Rio Grande near the coast.

Monomorium carbonarium ebeninum Forel: Although one of the most common ants in Puerto Rico (Smith, 1936; Wolcott, 1948), *M. carbonarium ebeninum* has apparently not yet penetrated Luquillo Forest. However, colonies were located in the yards of houses less than one half mile from the entrance to the forest. None were dissected from the stomachs of either frogs or lizards collected within the forest and none were taken at bait stations. Workers were occasionally found in the stomachs of frogs *Eleutherodactylus cochranae* and *E. coqui* collected in a wet pasture 2 miles east of Rio Grande near the coast.

Solenopsis geminata (Fabricius): This well-known tramp species is commonly found throughout Puerto Rico and the West Indies. Known as the "hormiga brava" by the natives, it is "a vicious, aggressive, stinging ant which normally nests in open sunny places" (Smith, 1936).

This species occurs in Luquillo Forest in open grassy areas created by the construction of roads. It has even been found on the slopes at El Yunque as high as 753 m. Mounds may exceed 30 cm in diameter and are constructed in such a manner that the overlying vegetation is not killed. Workers were often observed at the forest edge working inside the pods of *Inga vera*.

Table 1. Composition of colonies of *Solenopsis azteca* var. *pallida* collected in Luquillo Forest litter.

Date	Eggs	Larvae	Pupae	Workers	Queens
XII-30-69	20	32	4	36	4
I-14-70	?	?	?	41	2
I-14-70	?	?	?	24	2
I-14-70	6	67	17	52	6
I-14-70	77	107	50	78	2
I-14-70	?	?	?	34	4
IV-2-70	5	27	12	26	5
IV-2-70	0	53	17	80	2
IV-2-70	0	25	11	64	3
IV-2-70	28	14	4	18	3

In Luquillo Forest, this ant was dissected from the stomachs of *Anolis gundlachi* as well as from those of the frogs, *Eleutherodactylus coqui* and *E. karlschmidti*. Its absence from the stomachs of the other species of frogs probably reflects its inability to exist in the highly shaded forest environment. Near the coast, in a wet pasture 2 miles east of Rio Grande, workers were collected from the stomachs of the frogs, *E. coqui* and *E. cochranae*.

Solenopsis azteca var. *pallida* Wheeler: Several complete colonies were discovered in Luquillo Forest in the litter, some of them (XII-30-69, I-14-70) within decaying palm nuts (*Euterpe globosa* Gaertn.) and others (IV-2-70) inhabiting the individual hollow pith chambers of rotting limbs of *Cecropia peltata* (Table 1). The number of queens per colony ranged from 2 to 6 while numbers of workers varied from 18 to 80. In one instance 13 workers, 7 larvae and 4 pupae were found between two moist leaves in the leaf litter atop a large boulder in a palm stand.

Workers of this species were collected on various occasions "working" the green rind of *Dacryodes excelsa* fruits and the fruit of *Manilkara balata*. Additionally they have been found working inside the seed pods of *Inga fagifolia* and inside the dehiscent seed coat of *Guarea trichilioides* in the forest litter.

Workers were taken visiting four tumafish bait sites on August 11. Since two stations were in the crotches of trees at a height of approximately 2 m, it would appear that these ants are partly arboreal as well as primarily diurnal. At both stations, the first workers appeared at the bait at 5 am and the numbers exceeded 125 at each site within four hours. Since these numbers did not include those in transit and since the figures for colony size presented in Table 1

would indicate that colonies are normally small, it is presumed that more than one colony was represented at each site.

The other two bait sites where these ants were observed were at ground level. At one site, workers first appeared at noon, disappeared between 10–11 pm and reappeared at 3 am; by 7 am their numbers exceeded 200. At the other station, workers appeared at 4 pm, disappeared around midnight only to reappear at 6 am.

This ant is a common inhabitant of the forest. Indicative of this is the high rate of predation especially at lower elevations. Workers were dissected from the stomachs of two lizards, *Anolis gundlachi* and *A. evermanni*, and those of 8 species of *Eleutherodactylus*, namely *coqui*, *richmondi*, *portoricensis*, *wightmannae*, *eneidae*, *antillensis*, *brittoni*, *locustus* and *gryllus*. A female *Leptodactylus albilabris* was collected also which had fed on these ants. Additionally, specimens were recovered from stomachs of *Eleutherodactylus locustus* collected in the palm forest on El Yunque (elev. 753 m).

Solenopsis corticalis Forel: This species was originally described from specimens found by Wheeler (1908) nesting in a stem of a bamboo at Utuado. It was next encountered by Smith (1936) nesting in clay soil in a coffee grove 16 km east of Mayaguez and also attending the pineapple mealybug in a pineapple field near Lajas. Drewry (1970) picked up workers on a sticky trap in the forest in the vicinity of El Verde Field Station. Based upon its observed abundance in Luquillo Forest, it should probably be classified as a true forest inhabitant.

Like its near relative, *S. azteca* var. *pallida*, this species is attracted to sweet substances. Workers have been taken working the decaying fruits of *Guarea trichilioides* and *Sloanea berteriana* in the forest litter. Others have been captured while feeding beneath the seed coat of *Dacryodes excelsa*, inside the dehiscend seed coat of *Guarea trichilioides* and inside the seed pods of *Inga fagifolia*. Additionally, workers were collected at eight of the tunafish bait stations on August 11, indicating this species is probably omnivorous.

From observations made within the forest it would appear that this species is normally diurnal. Additionally, workers first appeared at bait stations during the daylight hours in all cases. However, once having appeared, workers were present throughout the night as well, often in numbers as high as 125.

With the exception of one colony found inhabiting a decaying palm nut (*Euterpe globosa*), all other colonies were located inside the hollow pith chambers of decaying limbs of *Cecropia peltata* lying atop the litter. On the average, colonies contained two to three times as many workers, ranging from 7 to 261, as those of *Solenopsis azteca* var. *pallida*. The number of dealated queens was also greater, varying

Table 2. Composition of colonies of *Solenopsis corticalis* collected in Luquillo Forest litter.

Date	Eggs	Larvae	Pupae	Workers	Queens
XII-11-69	77	101	40	113	5
XII-23-69	13	32	9	62	3
III-24-70	344	306	149	183	11
III-24-70	159	184	103	204	11
III-24-70	140	227	90	128	5
III-24-70	86	166	109	236	4
III-24-70	31	68	56	65	4
III-24-70	28	170	125	261	16
III-24-70	7	166	124	150	13
IV-20-70	0	14	2	7	6

from 3 to 16. Although colonies were dissected in December, March, April and July, no winged reproductives were found (Table 2).

Predators of this species include *Anolis stratulus* and *Eleutherodactylus coqui*, *E. portoricensis*, *E. richmondi*, *E. wightmannae*, *E. eneidae* and *E. brittoni*.

Solenopsis sp. (WW): Workers representing this unidentified species appeared in the stomachs of a *Eleutherodactylus coqui* juvenile, a *E. richmondi* male and *E. brittoni* males and juveniles in the forest around El Verde Field Station. It is probably a litter inhabitant like its relatives, since the smaller *E. coqui* juveniles and all stages of *E. richmondi* feed at the litter level.

FORMICINAE

Camponotus ustus Forel: In Luquillo Forest, *C. ustus* workers were encountered on several occasions, but only at night. Workers appeared at two bait stations on August 11 at 8 pm and disappeared at 5 am the following morning. Whenever workers were observed in the forest, they were on the vegetation. Additionally the two tuna-fish bait sites were in crotches of trees at a height of approximately 2 m indicating that this species is primarily arboreal.

On three occasions portions of colonies of *C. ustus* were found in dead vines of *Clusia krugiana*, 2 to 5 m above the ground in Luquillo Forest on El Yunque at an elevation of 753 m. Portions of another colony were found in a decaying branch of *C. krugiana* lying on the forest floor. What appeared to be a complete colony was located on June 3, 1970, in a dead tree on the forest floor in the same locale. No immatures were counted, but all adults were taken, numbering 257 workers, ranging in size from 5-7 mm, 13 male winged reproductives and one queen. Each limb contained several chambers located

beneath the bark and each chamber had a single entrance to the outside. Occasionally a few chambers, close together, would have a common entrance. Each chamber contained less than 25 workers with a few eggs, larvae and pupae. The eggs are elongate and transparent; the larvae being easily visible inside. Pupae were encased in a white cocoon.

Emergence of reproductives apparently takes place in midsummer. Winged reproductives were observed in flight on a clear night (June 23, 1970) following two weeks of almost steady rain. Additionally, winged males and females were found in the stomachs of a female *Eleutherodactylus portoricensis* and a male *E. coqui* on June 25 and in those of a *E. brittoni* juvenile and a male *E. coqui* on July 16.

Camponotus ustus workers were regularly consumed by *Anolis gundlachi* and *A. stratulus* as well as by *Eleutherodactylus coqui*, *E. portoricensis*, *E. richmondi*, *E. wightmannae* and *E. eneidae*.

An additional unpublished Puerto Rican record for this species is as follows: Bosque Estatal de Guanica (Rte 333, Km 6), V-26-70, climbing trees.

Myrmelachista ramulorum Wheeler: According to Wolcott (1948), *M. ramulorum* is the "only ant of economic importance of all the endemic ants of Puerto Rico." This "hormiguilla," as it is called by the natives has been recorded as nesting from sea level to El Yunque Peak (elev. 1065 m).

Myrmelachista ramulorum workers were occasionally observed in Luquillo Forest. Their secretive habits and arboreal tendencies made them difficult to detect. In one instance workers were encountered in chambers in a 3 m long decaying limb on the forest floor. Individual workers were also found beneath the bark of dead branches of *Clusia krugiana* vines at a height of approximately 5 m in the palm forest (elev. 753 m). Sixty-one workers were found feeding inside a pod of *Inga vera* and on another occasion a line of workers was encountered at noon crawling up and down a cement post which supported a walking bridge across a river in the forest.

On June 23, winged male and female reproductives were collected at a light. Smith (1936) reported that winged males were frequently seen at lights, but not females. He found winged females in a nest on December 13.

That this ant is relatively common in the forest is shown by its abundance in the stomachs of its predators. Three species of forest lizards, *Anolis gundlachi*, *A. stratulus* and *A. evermanni*, feed on them as well as *Eleutherodactylus coqui*, *E. portoricensis*, *E. richmondi*, *E. wightmannae*, *E. eneidae* and *E. gryllus*.

An additional unpublished Puerto Rican record for this species is as follows: Bosque Estatal de Maricao (Rte 120:Km 10, H11), V-27-70, arboreal.

Brachymyrmex heeri Forel: In Luquillo Forest, workers of this minute yellow species have been observed foraging at most hours of the day and night. While most observations have been of those on vegetation up to a height of 4 m above the ground, workers were found in the litter in one instance. Portions of a colony were located on June 8, 1970, in small chambers under a moss covering on dead branches of *Clusia krugiana* vines on El Yunque (elev. 753 m), 2 m above the substrate. Ten winged male reproductives also were found in this nest. Smith (1936) reported finding winged queens in a colony on February 14 and thus indicated the possibility of biyearly swarming.

This ant appears to be accepted quite readily by other ant species. Smith (1936) observed them "attending the hemispherical scale along with workers of *Wasmannia auropunctata*." On more than one occasion I have observed this ant crawling along the midrib of a palm leaf within a column of worker *Iridomyrmex melleus*. Part of a colony was uncovered in a rotting stump which was also being utilized by *Camponotus ustus*.

Brachymyrmex heeri workers were collected at eight of the tuna-fish bait sites, but none remained more than an hour. One *Pheidole moerens* soldier was encountered with a *B. heeri* worker hanging onto the soldier's antennae by its mandibles.

This species is another very common forest ant and occurs in the diet of both lizards and frogs. All four species of lizards, *Anolis gundlachi*, *A. stratulus*, *A. krugii* and *A. evermanni*, utilize this ant as food, as do *Eleutherodactylus coqui*, *E. portoricensis*, *E. richmondi*, *E. wightmannae*, *E. encidae*, *E. antillensis*, *E. locustus*, *E. brittoni*, and *E. gryllus*.

Paratrechina longicornis (Latreille): This introduced ant is a house pest throughout Puerto Rico and, at times of heavy rains, may move its entire colony onto interior walls of homes.

So far as is known, this species has not yet invaded Luquillo Forest, although colonies are present in houses bordering the forest. No specimens appeared at the bait stations and none were present in the stomachs of lizards and frogs collected in the forest. Near the coast, two miles east of Rio Grande, workers were found in the stomachs of *Eleutherodactylus coqui* juveniles collected at the edge of wet pasture.

Paratrechina cisipa Smith and Lavigne: This species was described by Smith and Lavigne (1973) from material collected from a colony nesting in a hollow of a living *Roystonea borinquena* tree.

This species is apparently nocturnal as evidenced by the following: (1) Workers have only been found in the stomachs of frogs (nocturnal feeders), not in those of lizards (diurnal feeders), (2)

files of workers have only been encountered at night and (3) visitations to bait sites occurred only between the hours of 7 pm and 7 am.

Workers were encountered in various parts of Luquillo Forest up to an elevation of 760 m at the Vereda Trail on El Yunque. The species appears to be primarily arboreal; files of workers often being seen climbing vertically up trees past the 22 m mark. However, on one occasion approximately 20 workers were discovered between leaves in the litter. When the flashlight passed over them, they retreated into cracks in the soil. Files of workers have also been observed crossing the ground to reach bait stations.

Workers appeared at five tunafish bait stations and as many as 200 workers were counted at individual stations at one time. Once files of workers were established, they continued to work the bait throughout the night. Numbers of workers present dropped rapidly between 4 and 6 am as light began filtering through the canopy.

Attempts were made to follow the files of workers back to their colonies, but after 18 to 23 m, they would disappear beneath the litter. A third file disappeared into a small hole in the bark of a living tree.

Three colonies were located accidentally, one in the hollow of the *Roystonea borinquena* tree previously mentioned, a second inside a rotton log supported 1 to 1½ m above the substrate and a third composed partly of cemented sawdust between the roots of a large tree. In all cases, colonies were large and contained several hundred workers. Winged reproductives were discovered in one colony on July 1.

Workers were found in the dissected stomachs of *Eleutherodactylus coqui*, *E. portoricensis*, *E. wightmannae*, *E. eneidae* and *E. karlschmidti*.

Paratrechina microps (Smith): The description of this endemic Puerto Rican species was based on "4 workers collected from the soil beneath a stone in a rather dense woods and not far from the edge of a stream" 14 km east of Mayaguez. No other specimen of this tiny-eyed ant with six mandibular teeth were recorded as being collected up to January 2, 1970, when I found the remains of some winged reproductives in the stomach of a female *Eleutherodactylus antillensis* frog in the vicinity of an intermittent stream bed in Luquillo Forest.

Subsequently workers were dissected from the stomachs of the frogs, *Eleutherodactylus coqui*, *E. portoricensis*, *E. richmondi*, *E. wightmannae*, *E. antillensis* and *E. karlschmidti* as well as those of the lizards, *Anolis gundlachi* (juveniles) and *A. evermanni* (males and juveniles). All efforts to locate workers in the field were unsuccessful, with the exception of a few workers found under a rock

in a forest trail, until the locations of capture of some calling male frogs were marked. On August 11, tumafish bait placed at three of these sites attracted small numbers of workers. In each case, 30–50 workers appeared from holes in the soil beneath huge boulders lying on the banks of the aforementioned intermittent stream. In one instance, workers were present from 7 pm until 4 am, in another, from 11 pm to 7 am and in a third, from 8 pm to 9 am indicating that this species is primarily nocturnal in habit. Because of the size of the boulders, no attempts were made to excavate colonies of this species.

Paratrechina sp., near *vividula* (Nylander): The identity of *P. vividula* remains open to question. According to Wheeler (1908), he had collected specimens from the mountains surrounding Utuado which agreed with the description of this greenhouse species supplied by Emery who had examined Nylander's types and traced the species to the Americas. However, Smith (1936) did not collect any specimens which he was "positive belong to this species." "Small yellow workers from a nest in the stem of a banana at Maricao were determined as this species by Dr. Wm. Mann" (Wolcott, 1948), and workers collected by Drewry (1970) by hand from the forest in the vicinity of El Verde Field Station were determined as *P. vividula* by Dr. William L. Brown. Specimens which I collected in Luquillo Forest were sent to Dr. D. R. Smith of the U.S. Dept. of Agriculture who determined them to be *Paratrechina* sp., near *vividula*.

Whatever the name, this species is a fairly common inhabitant of Luquillo Forest, although workers were rarely encountered foraging. The majority of colonies or portions of them were found within pith chambers of decaying limbs of *Cecropia peltata* in the forest litter. Part of one colony, which included one winged reproductive female, was located July 15, beneath a root mat atop a large boulder. Workers from another colony had tunneled in clay beneath a large rock, while a portion of a third colony, containing 55 workers, 22 larvae and 1 pupa, was located beneath the dehiscent seed coat of a *Sloanea berteriana* seed.

Colonies were small and, within the three which contained queens, only a single queen was discovered (Table 3). Several winged reproductives were found in a colony on April 13 and one male was taken from the stomach of a female *Eleutherodactylus wightmannae* collected on July 16.

Workers appeared in small numbers, not exceeding 30, at six bait stations, none of which were those utilized by *Paratrechina cisipa*. Visitations were primarily nocturnal, although at two sites workers began to appear at 3 pm and continued working throughout the night. In support of a nocturnal habit for these ants, they were

Table 3. Composition of colonies of *Paratrechina*, near *vividula*, taken from pith chambers of *Cecropia peltata* in Luquillo Forest litter.

Date	Eggs	Larvae	Worker pupae	Reproductive pupae	Queen	Winged reproductives	Workers
XII-30-69	4	5	0	0	1	0	5
I-22-70	0	41	1	0	0	0	140
III-24-70	187	131	149	0	1	0	141
IV-13-70	0	274	30	38	0	24	315
VII-2-70	162	130	122	0	0	0	209
VII-15-70	?*	?*	?*	0	1	1	80-90

*Not Counted

taken only by the night feeding frogs, not by the day feeding lizards. The frogs were *Eleutherodactylus coqui*, *E. portoricensis*, *E. wightmannae*, *E. encidae*, *E. brittoni*, *E. locustus*, *E. karlschmidti* and *Leptodactylus albilabris*. Some *Eleutherodactylus locustus* frogs containing these ants were collected from the mossy forest on El Yunque Peak (elev. 1000 m).

Paratrechina steinheili (Forel): Despite the fact that I encountered only one worker among the decaying flowers of wild banana on the forest floor in Luquillo Forest, these ants apparently are relatively common since workers were collected from the stomachs of six species of *Eleutherodactylus*, namely *coqui*, *portoricensis*, *eneidae*, *antillensis*, *brittoni* and *locustus* as well as in those of *Anolis krugii* males, females and juveniles. The *Eleutherodactylus locustus* males and females containing these ants were collected from the palm forest on El Yunque (elev. 753 m) indicating that this species occurs throughout the forest.

A portion of a colony, collected from a rotten log by the Quebrada Sonadora River on August 6, contained 54 workers, 6 male winged reproductives, 2 reproductive pupae, 78 worker pupae and 100 plus eggs and larvae.

DOLICHODERINAE

Iridomyrmex melleus Wheeler: This endemic species is certainly the most commonly observed ant throughout Luquillo Forest and may numerically exceed all others there. Workers could be seen at all times of the day filing up and down tree trunks and across the foliage. Despite their arboreal habit, a few workers found their way to each of 14 ground bait sites and to all three in crotches of trees. In most cases, these ants had disappeared by 9 pm, usually earlier, only to reappear at the bait around 7 am. In one instance, approximately 50 workers discovered the bait between 8 and 9 pm and con-

tinued working it until midnight and then reappeared at 6 am. Tuna-fish bait scattered on the bank of a roadcut on El Yunque peak (elev. 1000 m) attracted workers of *I. melleus* as late as 10 pm on June 8. One group of workers was noted tending purple aphid nymphs on "Bijao" (*Alpinia aromatica* Aubl. P. Guian). Two workers were observed at noon one day carrying a dead tachinid fly.

Portions of colonies were discovered in various habitats. One aggregation was inhabiting a small hollow in a living tree at a height of 3½ m, while another was living inside a decayed limb which was lying atop of a log. In the mossy forest on a slope of El Yunque Peak (elev. 1000 m), three colonies were discovered inhabiting decaying stems in the crowns of dwarf tree ferns. One group was found colonizing duff between the areal roots of a large tree, while on Monte Britton, 8 workers and 13 larvae were uncovered beneath a rock. One aggregation was found in association with a termite colony inside a decaying palm frond. Two mealybugs were also present.

However, the majority of *Iridomyrmex melleus* colonies were found utilizing the hollow pith chambers of decaying *Cecropia peltata* limbs lying on the forest floor. One colony, which utilized two sections, consisted of 1 queen, 528 eggs, 731 larvae, 5 pupae, 44 callows and 772 workers on December 30. Other colonies were not counted, but in the two instances where queens were found, there was only a single one per colony. Colonies uncovered on July 2 and 10 contained winged male reproductives. Smith (1936) had reported finding winged males and queen pupae in a nest on August 1.

Nearly every species of lizard and frog in Luquillo Forest used this ant for food; i.e., three species of *Anolis*, namely *gundlachi*, *stratulus* and *evermanni*, and ten species of *Eleutherodactylus*, namely *coqui*, *portoricensis*, *richmondi*, *wightmannae*, *eneidae*, *brittoni*, *locustus*, *hedricki*, *gryllus* and *karlschmidti*. A female *Leptodactylus albilabris* was found to have eaten them as well.

Apparently, in recent years, this ant has been able to expand its distribution beyond the limits of the forest environment. Workers were found in the stomachs of *Eleutherodactylus coqui* juveniles in a wet pasture 2 miles east of Rio Grande near the coast. A colony was located at a 3 m height in a hollow in a live tree at Humaco (Rte 30: Km 2, II4) and workers were collected from a dead limb lying on the soil near by (Rte 30: Km 2, II1). Additionally, one worker was taken from the stomach of a male *E. cooki* Grant collected in a cave formed by boulders on Route 3 just west of Yabucoa.

Tapinoma litorale Wheeler: I did not observe this forest species foraging in Luquillo Forest, but a few specimens appeared in the stomachs of *Eleutherodactylus coqui*, *E. portoricensis*, *E. wightmannae* and *E. eneidae*. Workers were also found in the stomach of

a male *Anolis stratulus*. The single colony located was found in a hollowed-out tree limb. In Maricao Forest, I observed a file of workers on a tree trunk at 10 pm on May 27.

Tapinoma melanocephalum (Fabricius): This tramp species is widely distributed throughout the West Indies where it is a common house pest. It has apparently not invaded Luquillo Forest proper, since no specimens were taken at bait sites or taken from the stomachs of the frogs or lizards. However, workers were collected from a bowl of sugar and feeding on a dead scorpion in a house on El Yunque (elev. 753 m). Also a colony was discovered on the floor beneath the data processing equipment at El Verde Field Station. Winged males and females were found in this colony on May 29. In a house outside the forest, workers were observed filing across an interior wall at 3 am.

Workers were found in the stomachs of males, females and juveniles of both *Eleutherodactylus coqui* and *E. cochranae* collected in a wet pasture, 2 miles east of Rio Grande.

Additional unpublished Puerto Rican records for this ant are as follows: Eusenada Comezon, III-15-70, colony in beach sand beneath coconut; near Guayama (Rte 3:Km 110, I18), V-25-70, inside a decayed coconut.

PONERINAE

Odontomachus sp.: This genus is currently being revised by Dr. W. L. Brown, Cornell University, Ithaca. Consequently it seems best not to designate a species pending the results of his study. During the daylight hours, workers were only encountered in Luquillo Forest when the forest litter was diligently searched. At night on two occasions between 10 and 11 pm, workers were observed foraging on rocks and on the banks of Quebrada Espiritu de Santo, but no colonies were located. On August 11, 1-7 workers were present at each of 4 bait stations from 7 pm through 5 am. At four times during the night 1-2 workers were counted at bait set in the crotch of a tree at a height of 5 m.

Winged reproductives were collected at lights at 9 pm on December 15 and 8 pm on March 11. Additionally, winged reproductives were taken from the stomach of a *Eleutherodactylus portoricensis* female on June 25. Smith (1936) found a "large number of winged queens in a nest on March 20 and males on April 5", indicating swarming may occur over an extended time period.

Wolcott (1948) indicated that these "ants form an appreciable item in the food of three species of lizards" and I found some in stomachs of a female *Anolis gundlachi* and a male *A. krugii*. Additionally, *Eleutherodactylus coqui*, *E. portoricensis*, *E. richmondi*, *E. wight-*

mannae and *Leptodactylus albilabris* utilize them as food in Luquillo Forest.

Anochetus mayri Emery: The extremely small colonies of *A. mayri*, usually consisting of approximately a dozen workers, are common throughout Puerto Rico in the soil under dead leaves and stones and in decaying stumps and logs (Wheeler, 1908; Smith, 1936).

Although I encountered no foraging workers in Luquillo Forest, one colony was discovered in a pith chamber of a decaying limb of *Cecropia peltata* in the forest litter. The colony contained 1 queen, 3 eggs, 8 larvae, 14 pupae and 22 workers.

Workers were collected in the palm forest on El Yunque (elev. 753 m) within the stomachs of *Eleutherodactylus brittoni* juveniles. Additionally, an occasional worker was found in the stomachs of *E. portoricensis*, *E. richmondi*, *E. eneidae*, *E. wightmannae*, *E. antillensis* and *Anolis gundlachi*, but no large numbers were consumed. Workers also were dissected from the stomachs of *Eleutherodactylus coqui* juveniles collected in a wet pasture 2 miles east of Rio Grande, near the coast.

Amblyopone sp.: The first record of a species of *Amblyopone* occurring in Puerto Rico was that of Drewry (1967) who found winged forms in a light trap within the forest near El Verde Field Station on September 24, 1965. Subsequently, I recovered workers from the stomach of a juvenile *Eleutherodactylus richmondi* collected in the same locale. However, no foraging workers were observed and the noticeable absence of this species from the stomach of frogs, feeding at the litter level, would seem to indicate that this species is rare.

Trachymesopus stigma (Fabricius): Individual workers and portions of colonies of *T. stigma* were encountered in various locations throughout Luquillo Forest from the lower reaches to the mossy forest (elev. 998 m) on the slopes of El Yunque Peak. This species is attracted to decaying fruits and I found workers crawling on the fruiting bodies of *Andira inermis*, *Guarea trichilioides* and *Micropholis garciniaefolia*. Portions of colonies, lacking a queen, were found under rocks, under decaying boards and in rotten logs. A complete colony was discovered on July 2, 1970, housed among the aerial roots of a large tree. Several chambers of varying sizes had been carved out of the decaying soft wet wood. The colony consisted of 1 queen, 51 workers, 9 larvae, 99 pupae, 13 female and 2 male winged reproductives. On the same date, part of a second colony was discovered utilizing five *Cecropia peltata* pith chambers. It contained 42 larvae, 105 pupae, 39 workers, 27 female and 4 male winged reproductives, but no queen was found. Winged female reproductives were also collected from chambers within a rotten log on July 15. Smith (1936)

reported finding winged males and females in nests on October 1 and November 20.

The workers do not appear to be subjected to intense predation, presumably because of their habit of foraging singly. The remains of individual ants were dissected from the stomachs of the lizard, *Anolis gundlachi*, and the frogs *Eleutherodactylus coqui*, *E. portoricensis*, *E. karlschmidti*, *E. richmondi* and *E. wightmannae* in Luquillo Forest. Additional workers were collected from stomachs of *E. richmondi* males taken in Maricao Forest.

Hypoponera opacior (Forel): The only previous Puerto Rican record for this species was that of Smith (1936), who collected some individuals in mountains 14 Km east of Mayaguez.

In Luquillo Forest, no colonies or foraging workers were observed. However, a few individuals were collected from the stomachs of *Eleutherodactylus coqui*, *E. wightmannae* and *E. locustus*.

Hypoponera ergatandria (Forel): In Luquillo Forest, *H. ergatandria* workers have been collected only at tunafish bait stations on the side of a bank formed by a roadcut through the mossy forest on El Yunque Peak (elev. 998 m). In the same locale, workers were collected from stomachs of *Eleutherodactylus locustus* males, females and juveniles on May 22 and June 8, 1970. Attempts to locate colonies of this nocturnal species were unsuccessful.

I wish to express my appreciation to my wife Freda and to Dr. George Drewry for the many hours they spent with me in the forest at night collecting frogs. I should also like to thank Dr. Drewry for identifying the frogs and lizards and Mr. Alejo Estrada for identifying the forest plants utilized by the ants. I would like also to express appreciation to Dr. Richard Clements for providing the support and facilities of the Puerto Rico Nuclear Center. Ant identifications were made or verified by Dr. David R. Smith, Systematic Entomology Laboratory, ARS, USDA. I should also like to thank Dr. Smith for critically reviewing this manuscript.

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NOTE

NEOTYPE DESIGNATION FOR *HEBRUS SOBRINUS* UHLER (HETEROPTERA: HEBRIDAE)

In an earlier note (1975, *Proc. Entomol. Soc. Wash.* 77(1):128), I pointed out that Uhler described *Hebrus sobrinus* twice in the same year, and that the description based on specimens from Denver (April 30, 1877, *Bull. U.S. Geol. Geog. Surv. Terr.* 3(2):452) has priority over the description based on specimens from New Mexico (June or later 1877, *Ann. Rept. Chief Eng. for 1877:1330*. "Wheeler Report"). In the same note, I established a lectotype female for the "New Mexico" specimens, and pointed out that the "Denver" type-material had not yet been located; a continued search has not been fruitful.

As two species of *Hebrus* (*buenoi* and *sobrinus*) occur at Denver and type-material cannot be found for Uhler's "Denver" *sobrinus*, the taxonomic status of the species is uncertain. It is desirable that the Denver and New Mexico forms be maintained as conspecific, hence I have selected a winged male from Denver, Colorado, (CL2, 1V-17-'61, J. T. Polhemus, in U.S. National Museum) as a neotype for Uhler's Denver species. It is conspecific with my lectotype of Uhler's New Mexico *sobrinus*. A label has been added "Neotype, *Hebrus sobrinus* Uhler, April 1877, J. T. Polhemus."

J. T. POLHEMUS, 3115 South York, Englewood, Colorado 80110.

THE LARVA OF *ACROBASIS BLANCHARDORUM*
(LEPIDOPTERA: PYRALIDAE: PHYCITINAE)¹

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ABSTRACT—The last stage larva of *Acrobasis blanchardorum* Neunzig is described. Morphological differences separating it from its closest known relative, *Acrobasis minimella* Ragonot, are discussed. In addition, notes on the host plant of *A. blanchardorum* and other aspects of its biology are presented.

The description of *Acrobasis blanchardorum* Neunzig was based on a series of moths collected with a light trap (Neunzig, 1973). Recently, information has been obtained in regard to the larva of this species and its host plant.

LAST STAGE LARVA

Color²: Head pale yellowish with indistinct pale brown muscle attachments; mandibles pale yellowish between articulations becoming reddish brown to brown along lateral margins and distally. Prothoracic shield and prespiracular plate pale yellow with indistinct pale brown muscle attachments (some living specimens with green undertones). Remainder of prothorax and mesothorax and metathorax yellowish white to brown or gray, with darker color imparted by numerous minute integumental granules (living larva green with purple on dorsum; mesothorax and metathorax more heavily suffused with purple); mesothoracic ring dark brown (black in living larva). Thoracic legs mostly pale yellow with some brown maculation. Abdomen similar to thorax, usually slightly darker (living larva mostly purple dorsally with some green undertones, and green and purple ventrally). Eighth abdominal segment ring brown to dark brown, incomplete. Anal shield pale yellow with indistinct pale brown muscle attachments. Peritreme of spiracles brown.

Structural Characters: Length of entire insect 17.5–18.5 mm. Width across abdominal segment 1, 2.3–2.5 mm. Width of head 1.54–1.55 mm. Mandibles (Fig. 1) with distoventral part strongly developed and chisel-like; sensilla styloconica (Fig. 2) shallowly bifid.

General appearance of *A. blanchardorum* (Fig. 3) similar to that of *Acrobasis minimella* Ragonot as described by Neunzig (1972), but, in addition to a distinctly larger overall size, different in at least the following morphological characters: Mandibles with disto-ventral part developed into a chisel-like structure (Fig. 1) (*A. minimella* without modification of mandibles (Fig. 36, Neunzig, 1972)). On the prothorax, distance between D1 setae less than between XD1 setae (Fig. 4) (*A. minimella* with distance between XD1 setae less than between D1 setae

¹ Paper No. 4768 of the Journal Series of the North Carolina Agricultural Experiment Station, Raleigh.

² Of preserved larva, unless otherwise indicated.

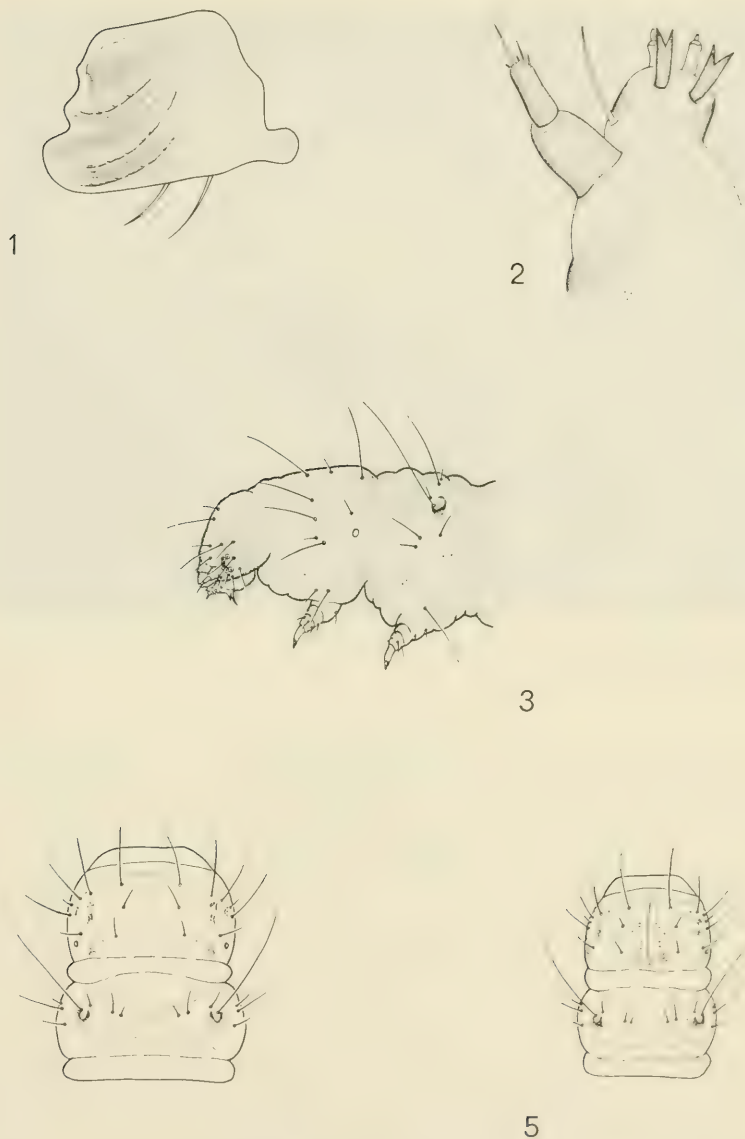


Fig. 1-4. Last stage larva of *Acrobasis blanchardorum*. 1, mesal view of right mandible. 2, mesal view of left maxilla. 3, lateral view of head, prothorax, and mesothorax. 4, dorsal view of prothorax and mesothorax.

Fig. 5. Dorsal view of prothorax and mesothorax of last stage larva of *A. minimella*, dorsal view of prothorax and mesothorax.

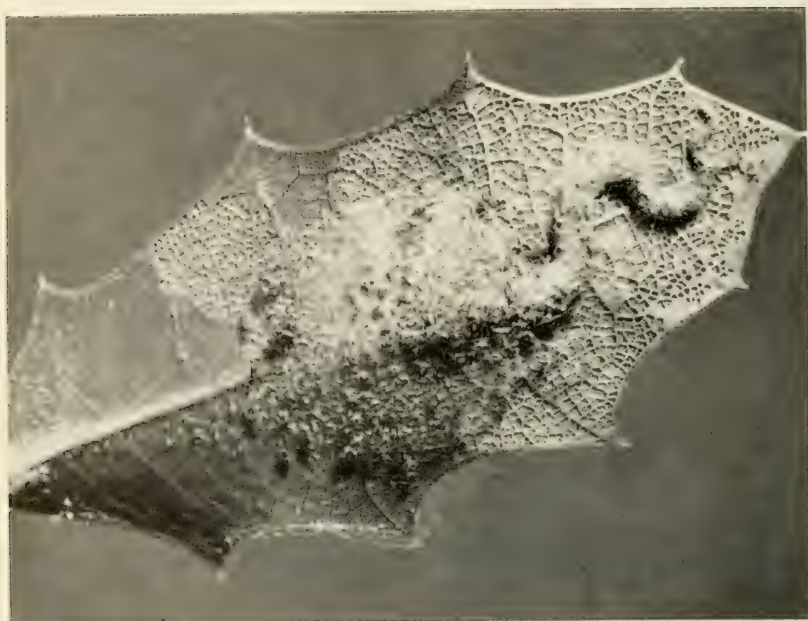


Fig. 6. Frass tube of partially grown larva of *Acrobasis blanchardorum* on undersurface of leaf of *Quercus grisea*.

(Fig. 5)); on the mesothorax, SD1 ring narrow posteriorly and posterior-dorsally (Fig. 4) (*A. minimella* with SD1 ring frequently broad posteriorly and usually projecting slightly posterior-dorsally (Fig. 5)); number of crochets on prolegs of abdominal segments 3, 4, 5, 6, and anal segment—44–52, 42–52, 46–54, 44–52 and 44–48, respectively (*A. minimella* with number of crochets on prolegs of abdominal segments—36–44, 37–40, 34–43, 34–50, and 30–38, respectively (Neunzig, 1972)).

Acrobasis blanchardorum shares with *A. minimella*, and a very few other phycitines, the unusual feature of having the thoracic shield and the prespiracular plate fused.

MATERIAL EXAMINED

TEXAS: FT. DAVIS, 3 larvae, *Quercus grisea* Liebmann, 9–IX–73, Coll. H. H. Neunzig. (Larvae collected when $\frac{1}{2}$ to $\frac{3}{4}$ grown and reared to last stage on *Quercus marilandica* Muenchhausen in North Carolina).

BIOLOGY

Larvae of *Acrobasis blanchardorum* collected near Ft. Davis, Texas, occurred on the under surface of *Quercus grisea* leaves within frass tubes (Fig. 6). Feeding habits and tube construction are very similar to those reported for *Acrobasis minimella* by Neunzig (1972). The

leaves of *Quercus grisea* are relatively small and the tube in its last stages of development must extend onto several leaves (since larvae were collected only when partly grown the exact appearance of the completed tube and the number of leaves eaten is not known).

Adults have been collected from early June to late August (Neunzig, 1973). Therefore, *A. blanchardorum* is either multivoltine or perhaps, as found by Opler (1974) for some oak-associated Lepidoptera in the western United States, it is univoltine with the adult long-lived.

The drawings were prepared by Mrs. Lily Shen.

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FELISTROPHORUS, A NEW GENUS OF MITES ON CATS IN PUERTO RICO (ACARINA: LISTROPHORIDAE)

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ABSTRACT—A new genus, *Felistrophorus*, is described for *Lynxacarus radovskyi* Tenorio. This mite, previously reported only from the Hawaiian Islands, is common on domestic cats (*Felis catus*) in Puerto Rico.

The cat fur mite recently described by Tenorio (1974) is here reported from Puerto Rico by a curious custom that all the Hawaiian species of Listrophoridae eventually get reported from Puerto Rico (Tamsitt and Fox, 1970). And it is interesting that I found the species common on cats in Puerto Rico at about the same time that it was found in Hawaii, October, 1972. It is for future research to show how widely the cat fur mite ranges and how it affects our beloved pets.

Felistrophorus Fox, NEW GENUS

Fig. 1-3

In both sexes prescapular and postscapular plates well developed but not completely separated from each other, joined at the midline by a sclerotized bridge. Postscapular plate with many tubercles arranged in transverse rows and posteriorly with a large pore. Tibiae I and II each with a long seta arising from a dorsal curved process. Male with lateral opisthosomal plates; Legs III and IV only slightly wider than Legs I and II; penis large, rod-like, anteriorly with a sclerite in the form of an inverted "U"; opisthosoma bilobed posteriorly, the lobes well defined. Female without opisthosomal plates; venter with a prominent sclerotized arch between Legs II and III.

Type-species: *Lynxacarus radovskyi* Tenorio.

DISCUSSION

The peculiar bridge joining the prescapular and postscapular plates (Fig. 1-3) distinguishes *Felistrophorus* from *Lynxacarus*, and so do other features. In *L. morlani* Radford, the type-species of *Lynxacarus*, the prescapular and postscapular plates are completely separated according to illustrations in Dubinina (1971) and Fain and Hyland (1974). The male of *L. morlani* lacks lateral opisthosomal plates, has greatly expanded posterior legs, and its penal sclerite is in the form of an inverted "Y"; but the male of *Felistrophorus radovskyi* has lateral opisthosomal plates, normal or slightly enlarged posterior legs, and its penal sclerite is in the form of an inverted "U".

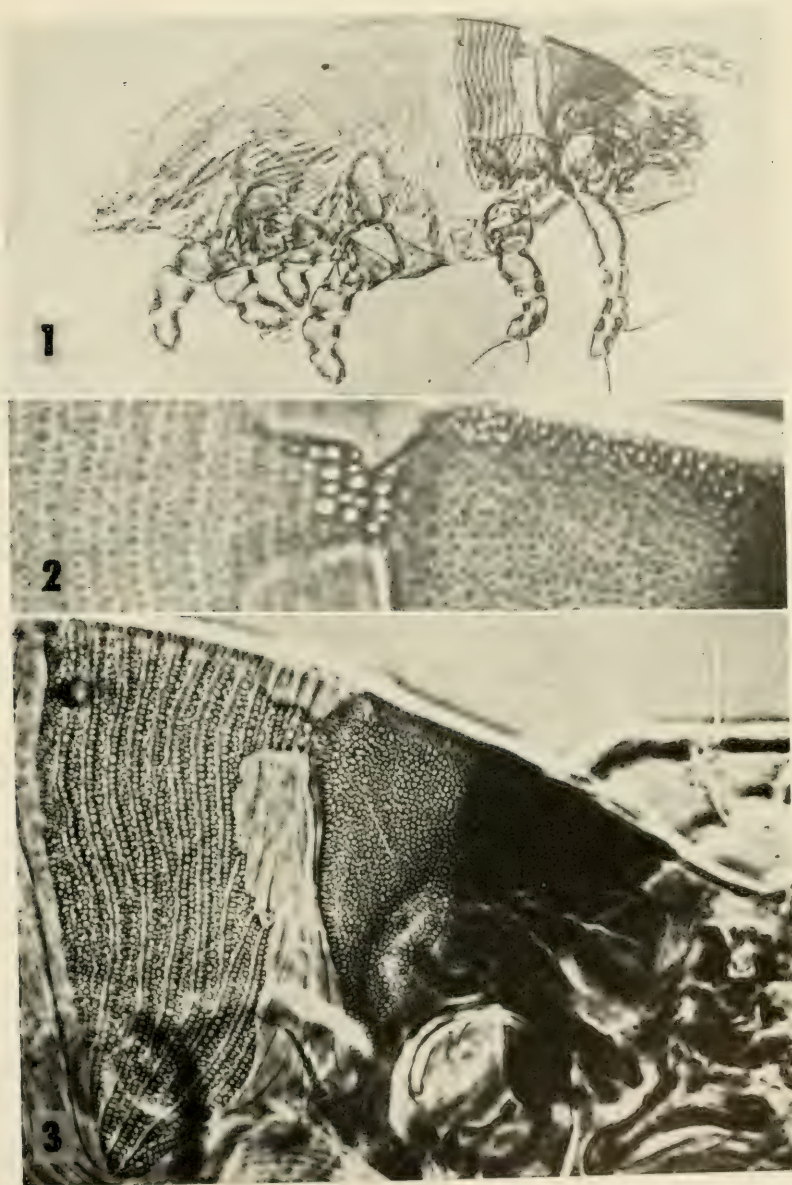


Fig. 1-3. *Felistrophorus radovskyi* (Tenorio) male. 1, dorso-lateral view. 2, detail of sclerotized bridge between prescapular and postscapular plates. 3, prescapular and postscapular plates.

Between October 2, 1972, and June 30, 1975, I examined thirty cats from northeastern Puerto Rico, and twenty-four of them were infested with *F. radovskyi*. Some records are: San Juan, Santurce, Ocean Park, on cat (Persian named "Shelly"), 2 October 1972, 1 ♀; 15 July 1973, 1 ♀, 1 ♂; 25 June 1975, 1 ♀, 1 ♂ (1975 material in the U.S. National Museum). Same locality, on cat (Persian named "Sheba"), 4 October 1972, 1 ♀, 1 ♂; 7 December 1973, 1 ♀; 29 October 1974, 1 ♂ (Figs. 1-3); 30 June 1975, 1 ♀, 1 ♂ (1975 material in the U.S. National Museum). Same locality, in house dust, 18 August 1975, 1 ♀, 1 ♂ (in the U.S. National Museum). On cats (American short hair) from: San Juan, Puerta de Tierra, School of Tropical Medicine Animal House, 27 December 1972, 1 ♀, 1 ♂; San Juan, Rio Piedras, Medical Sciences Campus, Tenth Floor, 6 July 1973, 1 ♀; 15 April 1974, 1 ♂. Toa Baja, 24 September 1973, 1 ♂. Guaynabo, 24 April 1973, nymph. Trujillo Alto, 23 April 1973, 1 ♂. Caguas, 14 November 1973, 1 ♀.

I thank Félix Liard for taking the photographs, Dr. Lawrence S. Ritchie for use of the camera in the Puerto Rico Nuclear Center, and Dr. Philip Specht for advice on photography.

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**ACALYPTOCOCCUS EUGENIAE: A NEW GENUS AND SPECIES OF
ERIOCOCCID FROM SINGAPORE (HOMOPTERA:
COCCOIDEA: ERIOCOCCIDAE)**

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ABSTRACT—*Acalyptococcus eugeniae*, a new genus and species of scale insect from Singapore, is described and illustrated. A discussion on the affinities of the genus is presented.

A new genus is proposed because of several morphological characteristics that distinguish it from existing genera of Eriococcidae. A description and illustration of the adult female is presented.

Specimen diagnostics were determined by using a phase contract microscope (160x – 2000x). Measurements of morphological characters, except for test measurements, are presented in microns as an average followed by the range in parentheses.

Acalyptococcus Lambdin and Kosztarab, NEW GENUS

This monotypic genus belongs to the family Eriococcidae and is restricted to the Oriental Region. The generic characteristics which distinguish this genus from other eriococcids are: the possession of segmental rows of bisclerotic, bifurcate microtubular ducts, distribution of dorsal setae, most of which are not enlarged, absence of macrotubular ducts, protruding anal lobes which are slightly sclerotized; ventrum with quinquelocular pores in a marginal band and in transverse segmental rows, and the arrangement of cruciform pores.

Etymology: The proposed generic name is Greek meaning "uncovered coccid" and refers to the lack of white fluffy wax on the dorsum.

Type-species: *Acalyptococcus eugeniae* Lambdin and Kosztarab.

Affinities: *Acalyptococcus* appears to be most closely related to *Scutare* Brittin based on the female's resting on a cushion of white powdery wax and having a pyriform body with dorsal abdominal segments heavily sclerotized, marginal and medial rows of setae on dorsum, 6-segmented antennae, area surrounding spiracles heavily sclerotized, and legs well developed with tarsus longer than tibia.

The genus may be distinguished from *Scutare* by the type of microtubular ducts present on the dorsum and the lack of such ducts on the venter (except on margin). The tubular duct of *Acalyptococcus*

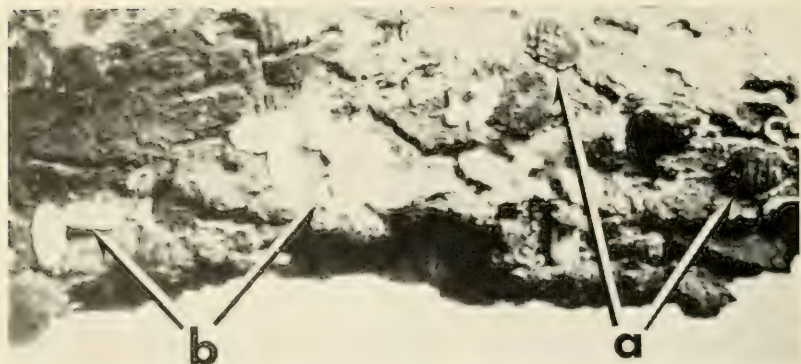


Fig. 1. *Acalyptococcus eugeniae*. a, adult females on host, *Eugenia linocieroides*, and showing powdery wax around margin. b, male pupal cocoons in cluster on host.

has a single distal orifice compared to bilocular openings in *Scutarea*. Other distinct differences between the two genera are the arrangement of cruciform pores and the majority of the pores on the margin and abdomen are quinquelocular in *Acalyptococcus* rather than septilocular as in *Scutarea*.

Acalyptococcus eugeniae Lambdin and Kosztarab, NEW SPECIES

Type-locality: Bukit Batok Forest, Singapore.

Type-material: The holotype and 4 paratypes on 5 slides deposited in the U.S. National Museum of Natural History, Washington, D.C.; other paratypes: 2(1), British Museum (Natural History); 1(1), University of Singapore, Singapore; 1(1), Institute of Zoology of USSR, Leningrad, Russia; 1(1), National Museum (Natural History) Entomology, Paris, France; 2(1), Waite Agricultural Research Institute, Adelaide, S. Australia; 2(1), Virginia Polytechnic Institute and State University, Blacksburg, VA.; 8(4), University of Tennessee, Knoxville, TN. From *Eugenia linocieroides* King (Myrtaceae), Bukit Batok Forest, Singapore, coll. D. H. Murphy and M. Kosztarab, 2 Aug. 1972, (PL 104a-r).

Habits: Adult female and immature stages were found in close proximity to each other on the host. Adult females (Fig. 1a) and male cocoons (Fig. 1b) are usually separated; however, several males were found to be closely associated with an adult female. The population of scale insects was found to be protected by the shelter of ants (*Camponotus* sp.).

Description: *Female* (Fig. 1a): Pyriform, reddish brown in color, resting on cushion of fluffy, white wax; 1.0–2.0 mm long, 1.0–1.5 mm wide.

Male pupal cocoon (Fig. 1b): Elongate, felt-like, white; 1.0–1.5 mm long, 0.5–0.8 mm wide.

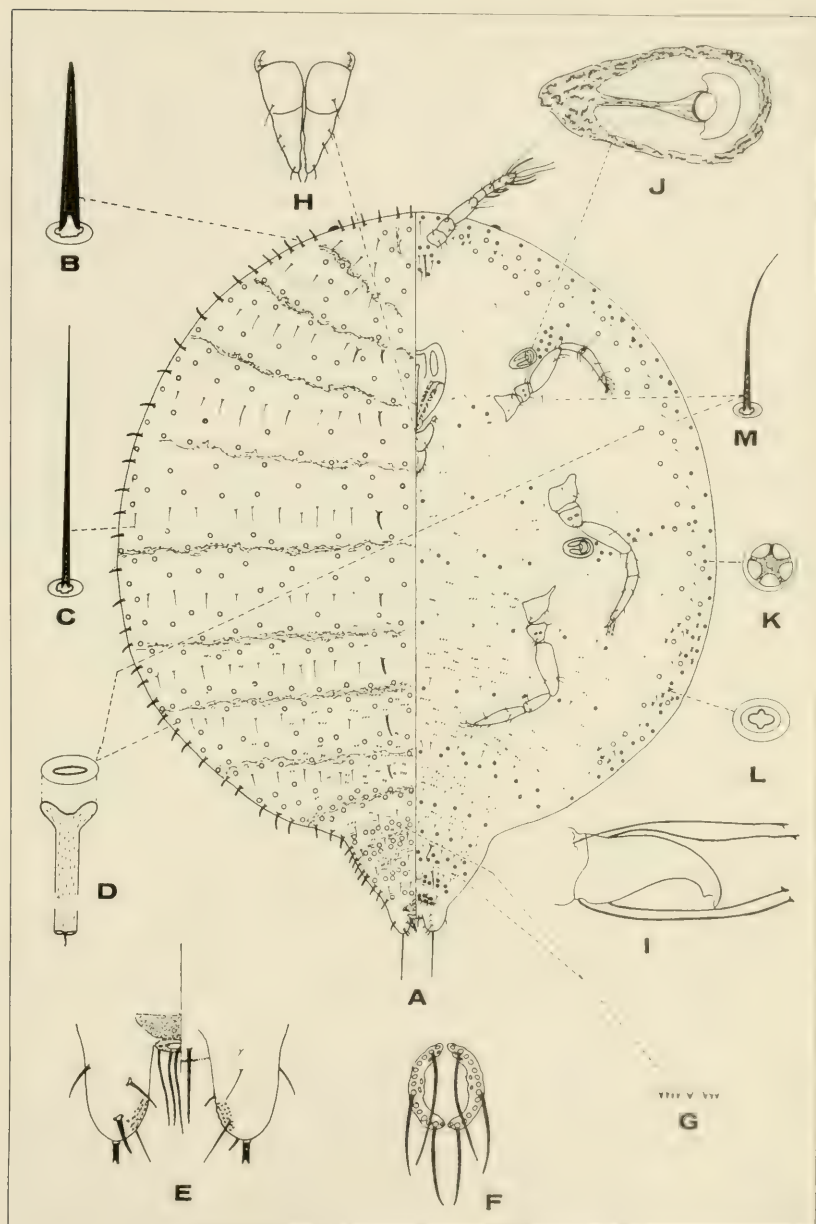


Fig. 2. *Acalyptococcus eugeniae*. A, dorsoventral view. B, marginal seta. C, segmental seta. D, microtubular duct. E, anal lobes. F, anal ring. G, microspines. H, labium. I, claw. J, spiracle. K, quinquelocular pore. L, cruciform pore. M, body seta.

Body (Fig. 2A): Slide mounted female 1459(1330–1600) long, 1081(855–1330) wide, pyriform, tapering posteriorly. Derm heavily sclerotized dorsally with the exception of a transverse band at constriction of abdominal segments, and membranous ventrally.

Dorsal surface. Setae: A marginal row of spinelike setae (Fig. 2B) extending from head to anal lobes, 2–4 per segment, each 33.6 (27.6–53.0) long; 7 or 8 pairs of thick setae medially positioned on cephalothoracic and abdominal segments, 24.8 (18.4–29.9) long, similar in shape to marginal setae; segments with a row of hairlike setae (Fig. 2C) 50.0 (29.3–68.5) long. *Microtubular ducts* (Fig. 2D): Short and broad, distal orifice oval, ductile usually bisclerotic, with minute medial filament extending proximally, arranged in segmental rows or bands, most numerous on margin; surface size 4.1 (3.1–4.6) long, 2.9 (2.5–3.4) wide. *Anal lobes* (Fig. 2E): Triangular, with minute sclerotized bosses on inner margins. *Dorsum* of each lobe with 3 spinelike setae 37.8 (25.3–57.1) long and an apical seta 153 (138–180) long. *Venter* with a slender seta, 25.0 (11.5–39.0) long, on anterior $\frac{1}{2}$ and a hairlike to spinelike seta, 52.4 (39.1–59.3) long, on posterior $\frac{1}{2}$ of each lobe on inner margin, usually a pair of stout midventral setae, 18.9 (13.7–27.7) long. *Anal plate* (Fig. 2E): Triangular, 40.5 (34.5–50.6) long, 54.1 (46.6–69.1) wide. *Anal ring* (Fig. 2F): Located beneath anal plate, subcircular, divided medially, 53.8 (48.8–58.6) long, 37.8 (32.2–44.4) wide; with 6 setae, each 96.1 (92.0–106) long. Setae bordered by an outer row of pores and a few pores on inner margin. *Microspines* (Fig. 2G): Minute, positioned in transverse middorsal clusters primarily on posterior abdominal segments.

Ventral surface. Eyes (Fig. 2A): Poorly developed, represented by small sclerotic areas on margin outside antennae; in slide mounted specimens each 24.8 (23.0–32.0) in diameter. *Antennae:* Compact, 6-segmented, 169 (149–181) long, width of base 40.5 (32.2–48.3). Scape 31.8 (27.6–46.6) long. Segments II to VI: 28.8 (25.3–32.2), 46.7 (29.9–50.6), 14.1 (13.8–16.1), 14.9 (13.8–18.4), 27.2 (20.6–32.2) long respectively. Segments: I with 3 or 4 hairlike setae, II with 1 or 2 slender setae and a sensory pore, III with 3 long setae, IV with 1 fleshy and 1 slender seta, V with 2 fleshy and 2 or 3 slender setae, VI with 3 fleshy and 3 to 5 hairlike setae. *Clypeolabral shield:* Length 135 (126–148), width 100 (89.3–110). *Labium* (Fig. 2H): Triangular, 3-segmented, 89.1 (80.5–92.3) long, 63.6 (55.2–80.5) wide; with 14 slender setae (2 basal, 1 medial, and 4 apical pairs) each 19.7 (9.20–34.5) long. *Legs:* Trochanter with a pair of pores medially positioned, with only a slight division suture. *Claw* (Fig. 2I) with denticle; tarsal and claw digitules present, each 33.7 (23.0–39.1) long. Leg setae spinelike to hairlike.

Part of leg	Prothoracic leg	Mesothoracic leg	Metathoracic leg
Coxa	36.5 (32.0–38.4)	36.0 (32.1–40.5)	38.8 (34.5–46.0)
Trochanter	31.3 (23.8–34.5)	33.0 (27.6–34.5)	30.5 (25.3–34.3)
Femur	81.1 (75.9–98.9)	80.9 (78.1–82.8)	87.3 (78.1–115)
Tibia	45.4 (43.0–46.0)	46.5 (45.5–48.3)	51.5 (46.0–57.6)
Tarsus	73.9 (69.0–80.6)	75.0 (71.6–80.5)	83.7 (80.5–92.0)
Claw	14.1 (13.0–16.1)	20.7 (18.4–23.0)	17.9 (13.6–20.7)
Entire leg	282 (268–287)	292 (285–298)	310 (298–328)

Spiracles (Fig. 2J): Thoracic spiracles enclosed in scleroses. Anterior 31.5 (29.3–34.5) long, 16.3 (14.4–19.6) wide, atrial aperture 6.5 (5.6–6.9) in diameter. *Pores*: Primarily quinquelocular (Fig. 2K), few septilocular, positioned in clusters or rows in cephalothorax, spiracular pores extending from spiracles to margin, in transverse abdominal rows 1, occasionally 2 pores wide; few trilocular pores in cephalothoracic margin; each 4.7 (3.6–5.1) in diameter. Cruciform pores (Fig. 2L) in groups of 3–12 pores, positioned laterad of antennae and on margin of abdominal segments, each 5.5 (4.9–6.8) long, 4.7 (3.8–4.9) wide. *Setae* (Fig. 2M): Cluster of 8 or 10 setae between antennae, 2 stouter than rest; other slender, hairlike setae positioned in transverse segmental rows; each 25.2 (10.7–40.7) long; with a pair of stout setae near vulva 34.6 (25.4–40.5) long; a pair of stout, spinelike, suranal setae positioned at apex of anal cleft 71.9 (58.6–80.6) long. *Microtubular ducts* (Fig. 2D): Located in marginal and submarginal areas only, shape and size similar to those on dorsum. *Microspines* (Fig. 2G): Transverse midventral clusters on each abdominal segment, more numerous on posterior segments.

Etymology: The species name is derived from its host plant.

Sincere appreciation is extended to Douglass R. Miller, Systematic Entomology Laboratory (SEL), U.S. Department of Agriculture (USDA) for reviewing this manuscript before publication. In addition, we wish to thank George C. Steyskal, SEL, USDA, for verification of our proposed generic and species name, and Lewis L. Deitz, Department of Scientific and Industrial Research, New Zealand, for the loan of type material of the genus *Scutare*.

SYMPATRY OF *TRITOXIA INCURVA* LOEW AND *TRITOXIA FLEXA* (WIED.) (DIPTERA: OTITIDAE)

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ABSTRACT—Sympatric populations of *Tritoxa flexa* (Wied.) and *T. incurva* Loew occurring at Cincinnati, Ohio, are described. It is shown that *T. incurva* breeds in late August and in September whereas *T. flexa* breeds from early spring until late summer. At Cincinnati more than 35% of the *T. incurva* eggs may hatch without exposure to low temperatures if moisture conditions are suitable. Also the *T. incurva* population is approximately ten times as large as the *T. flexa* population. With the large population and significant hatching rate of *T. incurva*, competition for *Allium* bulbs probably occurs in September. However, severe competition in September will not upset the sympatric association since *T. flexa* larvae that hatch in August will overwinter and give the spring *T. flexa* population.

The genus *Tritoxa* includes five species (Steyskal, 1965). *Tritoxa incurva* Loew and *T. flexa* (Wied.) have overlapping ranges in much of eastern and midwestern United States, whereas *T. cuneata* Loew, *T. pollinosa* Cole, and *T. ra* Harriot are all western species. The major works on *Tritoxa* biology are Manis (1941) for *T. flexa*, and Allen and Foote (1975) for *T. incurva*. The latter authors also compare and contrast the biology of the two species. The known larvae of *Tritoxa* are all phytophagous and apparently feed in *Allium* bulbs.

Sympatry of *Tritoxa flexa* and *T. incurva* has been reported several times in the literature (Loew, 1873; Manis, 1941; Downing, 1976). Also Downing reported that both species have a common host at Cincinnati, wild garlic (*Allium vineale* L.). In contrast, at Kent, Ohio, *T. flexa* is not overly common and usually is not found in the same habitat as *T. incurva* (B. A. Foote, personal communication).

This paper, based on a field study and associated laboratory work, presents findings on the sympatric association of *T. flexa* and *T. incurva* at Cincinnati, Ohio. A few comments on the possible significance of these results are also given.

METHODS AND RESULTS

Adults of both species were found together on a gently sloping hillside covered with kneehigh grass. A plot 6 by 9 m was selected, with similar vegetation cover extending in all directions outside the plot. A count of the specimens seen in a 1 hour period, from 30 minutes before until 30 minutes after sundown, was usually taken 2× a week during 1973 with the exception of a 2-week period in mid-June. Occasional counts made in 1974 and 1975 indicate that the population data obtained in 1973 are not unusual.

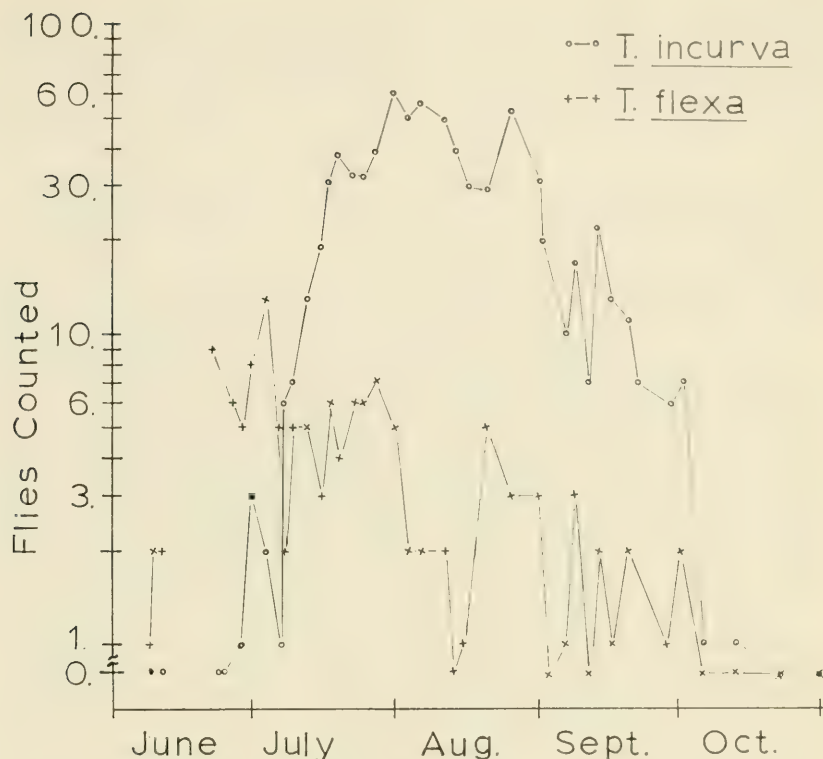


Fig. 1. Numbers of *Tritoxa incurva* and *T. flexa* adults counted in an observation plot during a one-hour period.

The results of the count are shown in Fig. 1. The ordinate is logarithmic except that a zero is included, to allow a convenient comparison of the *T. flexa* and *T. incurva* numbers. Figure 1 shows that the *T. incurva* population is about $10\times$ larger than that of *T. flexa*. Also adults of *T. flexa* appear earlier in the season and become most numerous earlier than those of *T. incurva*.

Data were obtained on the time of mating for both species. Breeding pairs of *T. flexa* were seen on VI-10, VI-30, VII-2, VII-5, VII-9, VII-19, VII-24, and VIII-29. Breeding pairs of *T. incurva* were seen on VIII-30, IX-1, IX-21, and IX-29. Laboratory observations of *T. incurva* gave results similar to the field observations. Couples caged in the laboratory were never seen to breed during June and July. The earliest breeding of *T. incurva* in the laboratory occurred when a pair captured in nature on 28 July bred on 17 August.

Data on the intensity of the *T. incurva* egg diapause at Cincinnati were obtained as follows. Twenty-six eggs were divided into groups of 13. One group of eggs was placed on moist paper toweling in a plastic petri dish. The other group was placed in a similar dish with moisture present, but the eggs were resting on aluminum foil. The laboratory temperature was between 20

and 25°C. The light period was about 15 hours each day. Five of the eggs resting on the moist paper toweling hatched 10, 12, 23, 34, and 35 days after they were laid. Three of the eggs kept dry hatched 18, 35, and 36 days after they were laid.

DISCUSSION

The natural history of *T. flexa* is described by Manis (1941). There are two and a partial third generations a year, with the third generation larvae overwintering in the ground or in *Allium* bulbs. In contrast, Allen and Foote (1975) report only one generation a year for *T. incurva*. Their laboratory work indicated that mating only took place late in the season, although they never observed mating in nature. My field observations and laboratory investigations are consistent with the above results.

Allen and Foote (1975) also reported that less than 25% of *T. incurva* eggs hatched at Kent, Ohio, during the fall months if kept at 20 to 25 C. In the present study the egg hatching percentage was greater than 23% for dry eggs and probably approached 38% in the field since moisture is present. The somewhat longer and colder winter season at Kent, in northern Ohio, may account for the different intensity of diapause. Allen and Foote also state that larval competition between *T. incurva* and *T. flexa* is unlikely at Kent, Ohio, because of the larvae of the two species feed at different times, spring and summer respectively. Competition in late summer at Cincinnati seems likely as discussed below.

The data of Manis (1941) give a *T. flexa* generation time of about 60 days, therefore eggs laid after 1 August probably yield overwintering larvae. Also, since *T. incurva* apparently does not breed until mid-August, the eggs not overwintering probably hatch in September. Comparison of the dates of larvae hatching show that first instar larval competition for *Allium* bulbs, at Cincinnati, is possible in September but not in August. Considering the relative size of the populations, a 23 to 38% egg hatching rate for *T. incurva* suggest that *T. flexa* larvae may suffer serve competition for bulbs during September. However, regardless of the September competition the sympatric relation of the species can be maintained by the overwintering *T. flexa* larvae that hatch before competition for bulbs begins. In addition the limited time that *T. flexa* produces overwintering larvae before *T. incurva* eggs hatch may explain the relatively smaller numbers of *T. flexa* shown on Fig. 1.

Consideration of *T. incurva* natural history suggests the species may be phylogenetically younger than *T. flexa* since it appears to be still adapting to its environment. For instance, breeding only after the population peak has passed does not appear optimum for mate selection; also the variable egg diapause requirements indicate on-

going adaptation. In addition it is probably safe to assume that *T. flexa* and *T. incurva* are genetically related by considering their very similar morphology and sympatric distribution. Taken together the present data suggest that *T. incurva* evolved from *T. flexa* or from a common ancestor more recently than did *T. flexa*.

I thank Professor B. A. Foote, of Kent State University, for his critical review of the manuscript.

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NEARCTIC HALIPLIDAE, IV.¹
NEW HALIPLUS FROM CANADA (COLEOPTERA: HALIPLIDAE)

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ABSTRACT—*Haliphus allisonae* is described on the basis of sixteen specimens from British Columbia. A key and illustrations are provided to distinguish it from several similar species, especially *H. distinctus* Wallis, to which it keys in the most recent revision of the genus.

In the course of examining Haliplidae from Canada, an undescribed species of *Haliphus* was encountered from Creston, British Columbia. It belongs to the subgenus *Haliphus*, s. str., as defined by Wallis (1933).

Haliphus (Haliphus) allisonae Brigham, NEW SPECIES

Diagnosis: Elongate, medium-sized *Haliphus* (Fig. 1) of reddish-brown color, with elytron shining, indistinctly maculate except for a medial sutural blotch; darkened stria punctures; prosternal ridge constricted, slightly channeled; metasternum depressed anteriorly, obliquely impressed laterally posterior to middle coxae; elytral apex sinuate; pronotal margin unbeaded anteriorly, often evidently not continuous with elytron laterally; pronotal plica long; anterior protarsal claw of male shorter and thicker than posterior protarsal claw; right paramere of male genitalia with an apical bristle, left paramere densely set with thick hairs, digitus absent, aedeagus resembling *Haliphus distinctus* Wallis, but with a large dorsal lobe. Keys to *Haliphus distinctus* in Wallis (1933) and Hatch (1953) but differs in the distinctive type of genitalia of male and the lack of elytral micropunctures in female.

Haliphus allisonae keys to *H. distinctus* in Wallis (1933). The following modifications of his key are necessary to include the new species. *Haliphus stagninus* Leech and *H. falli* Mank, described after Wallis' revision, also are included in the key.

- | | |
|---|-----------------------------------|
| 4. Elytron with blackish uninterrupted longitudinal lines formed by the close-set, blackened punctures, but without blotches | 5a |
| Elytron with more or less definite blotches, never with uninterrupted lines | 5b |
| 5a. Robust, average length 3.4 mm; aedeagus almost L-shaped, with distinct subapical angle dorsally; elytron of female shining | <i>Haliphus stagninus</i> Leech |
| Smaller, average length 3.0 mm; aedeagus almost L-shaped, but smoothly curved dorsally; elytron of female strongly alutaceous | <i>Haliphus strigatus</i> Roberts |
| 5b. Prosternal process evidently channeled; aedeagus broad, with prominent dorsal lobe; left paramere with hairs variable | 6a |

¹ Nearctic Haliplidae, parts I through III (un-numbered) are Brigham and Sanderson (1972, 1973, 1974), respectively. See reference section.

- Prosternal process not or very feebly channeled; aedeagus elongate, slender, without prominent dorsal lobe; left paramere with hairs rather sparsely placed along ventral edge 7a
- 6a. Mid-metasternum not furrowed nor longitudinally impressed at sides; male protarsal claws equal *Haliphus dorsomaculatus* Zimmermann
- Mid-metasternum longitudinally impressed at sides; male protarsal claws unequal, anterior claw shorter and thicker than posterior claw 6b
- 6b. Aedeagus with very prominent dorsal lobe; elytron of female shining, without micropunctures *Haliphus allisonae*, new species
- Aedeagus with dorsal lobe present, but much less prominent; elytron of female dull, densely covered with micropunctures. *Haliphus distinctus* Wallis
- 7a. Margins of pronotum and elytron evidently not continuous, base of pronotum plainly wider than bases of elytra; side margin of pronotum wide for the genus *Haliphus hoppingi* Wallis
- Margins of pronotum and elytron nearly or quite continuous, base of pronotum equal to or scarcely wider than bases of elytra; side margin of pronotum narrow as usual in the genus 7b
- 7b. Left paramere of male genitalia with hairs sparsely placed along nearly the entire ventral side; aedeagus evenly curved, not narrowed apically *Haliphus falli* Mank
- Left paramere of male genitalia with hairs confined to apical $\frac{1}{3}$ of the ventral side; aedeagus elongate, narrowed apically *Haliphus longulus* LeConte

Holotype male: Ovale, widest approximately $\frac{1}{3}$ distance from humeral region of elytra to apex (Fig. 1). Greatest width 1.83 mm; greatest length 3.42 mm. *Head*: Maximum width of head through eyes 0.67 mm; minimum width of head between eyes 0.38 mm; punctures on vertex blackened, larger than on rest of head; 5 impunctate areas distributed as follows: Medially anterior to insertion of antennae, medially between posterior margins of eyes, on each side of midline on a line passing through center of eyes, and laterally posterior to each eye; eye ringed with narrow dark margin, rest of head reddish brown. *Pronotum*: Width at apex 0.75 mm; width at base 1.33 mm; length along midline 0.75 mm; disc reddish brown; punctuation coarse posteriorly, finer elsewhere; small impunctate area on each side of midline medially; posterior $\frac{1}{2}$ of midline impunctate; lateral margin beaded, evidently not continuous with elytron; base of pronotum plainly wider than bases of elytra; plica deep, 0.33 mm long. *Elytron*: Shining, without micropunctures; margin smooth, beaded except for apical region; apex slightly sinuate; striae punctures darkened, especially in 4 principal rows nearest suture, the rows uninterrupted; a row of finer punctures between striae rows, regularly spaced, but with only $\frac{1}{2}$ as many punctures as the striae rows, a row of fine punctures between 1st striae row and sutural margin, extra punctures suggesting 2nd subsutural row anteriorly; elytral reddish-black markings indistinct against brown background, distributed as follows: Medial sutural blotch coalescent with suture, extending laterally to 4th striae row, prolonged posteriorly suturally; post-medial sutural blotch indistinct, not coalescent with suture, between 2nd and 3rd striae rows; postmedial discal blotch very indistinct, between 5th and 6th striae rows. *Venter*: Width of prosternum at apex 0.25 mm, at base 0.27 mm, at constriction between front coxae 0.27 mm, obscurely margined, very slightly channeled; apex of metasternal process depressed, below base of pro-

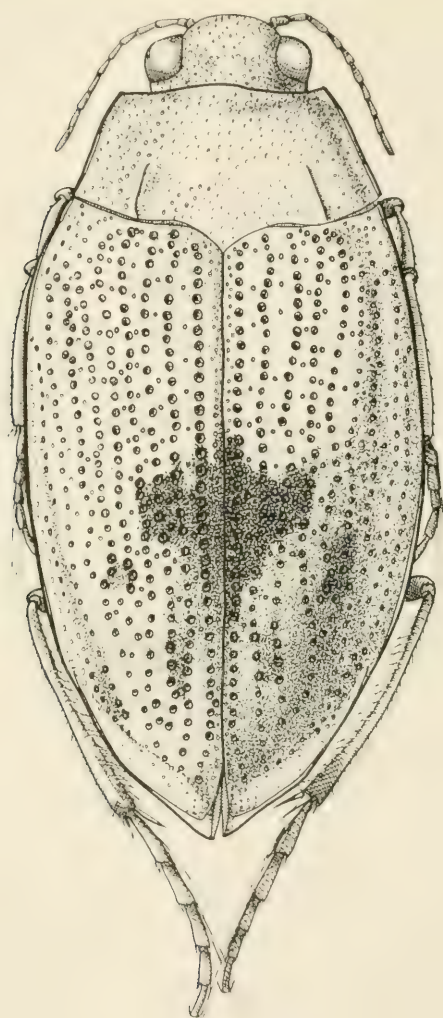


Fig. 1. *Haliphus allisonae*, holotype male.

sternal process, with an impunctate area medially, impressed medially posterior to impunctate area, obliquely impressed laterally posterior to middle coxae, the impressions with coarse punctures; sterna impunctate anteriorly, each with irregular bands of fine punctures posteriorly, front and middle coxae microreticulate proximally, shining distally; hind coxal plate rounded posteriorly; front and middle femurs shining proximally, microreticulate distally; hind femur microreticulate; tibiae and tarsi microreticulate; legs reddish brown, darker near joints; basal 3 segments of front and middle tarsi each enlarged toward apex, basal 4 segments

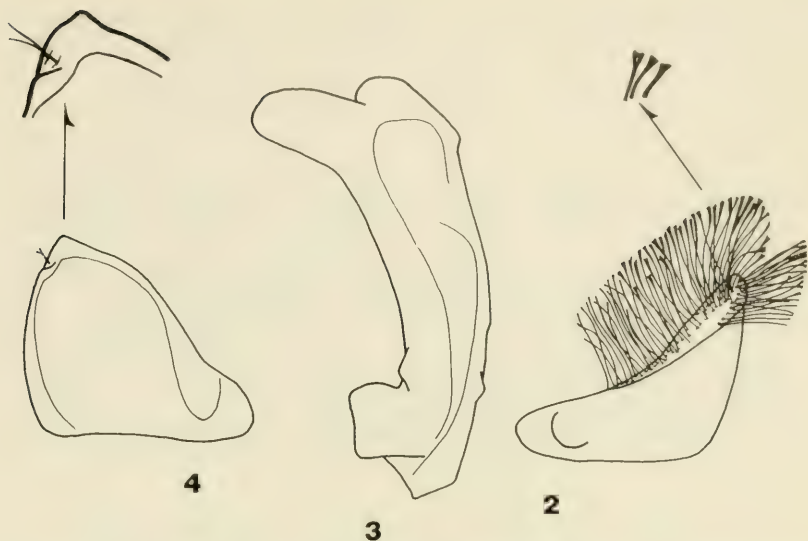


Fig. 2-4. *Haliplus allisonae*, holotype male, male genitalia. 2, left paramere. 3, aedeagus. 4, right paramere.

each with specialized setae. *Genitalia*: Left paramere (Fig. 2) triangular, concave on ventral margin, with coarse setae along apical $\frac{3}{5}$ of ventral margin, setae not confined to ventral margin apically, but extending laterally, digitus lacking; aedeagus (Fig. 3) about $3.5\times$ longer than wide, apex rounded, dorsal lobe large, continuing along $\frac{1}{5}$ of aedeagus, expanding apically, widest point of aedeagus $\frac{1}{3}$ in from apex, dorsal lobe thick except for apex, which is thin and bladelike; right paramere (Fig. 4) triangular, outer surface with setigerous punctures, apical margin sharply rounded, notched, notch containing a pair of bristles.

Allotype female: Similar to holotype except basal 3 segments of front and middle tarsi not enlarged toward apex and basal 4 segments of front and middle tarsi lack specialized setae. Greatest width 1.67 mm; greatest length 3.29 mm.

Types: Holotype σ , Allotype σ , and 7 σ and 7 σ paratypes: British Columbia, Creston, King Creek, 22 September 1955, G. Stace Smith. Holotype and allotype are in the Illinois Natural History Survey collection, paratypes distributed among National Museum of Natural History, California Academy of Sciences, Canadian National Collection, and the author's collection.

Variation: Gross variation within the type-series of *Haliplus allisonae* is limited to body measurements: Eight males ranged in length from 3.08 mm to 3.42 mm (mean length $3.24 \text{ mm} \pm 0.11 \text{ mm}$) and in width from 1.67 mm to 1.83 mm (mean width $1.71 \text{ mm} \pm 0.06 \text{ mm}$); eight females ranged in length from 3.04 mm to 3.54 mm (mean length $3.27 \text{ mm} \pm 0.15 \text{ mm}$) and in width from 1.58 mm to 1.79 mm (mean

width $1.70 \text{ mm} \pm 0.08 \text{ mm}$). Dividing width by length gave a mean value of 0.528 ± 0.010 for males and 0.521 ± 0.012 for females.

The illustration in Fig. 1 was prepared by Ms. Peninnah Smith.

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ALFALFA BLOTCH LEAFMINER (DIPTERA: AGROMYZIDAE)
LABORATORY STUDIES OF BIOLOGY IN EUROPE¹

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ABSTRACT—Females (1 to 2 day-old) of the alfalfa blotch leafminer, *Agromyza frontella* (Rondani), an introduced agromyzid that is a serious pest on alfalfa in the eastern United States oviposited readily in the laboratory on the under surface of alfalfa leaflets. The newly deposited eggs measured 0.35 mm long, and eggs hatched 5–6 days after oviposition. Larvae cut their way out of mines 5–6 days after the mines became visible. The cycle from egg to adult emergence required about 33 days. In France, parasitism of field-collected *A. frontella* larvae by diverse species often ranged from 70 to 90%. Several of these parasitoid species are being considered for introduction into the US as natural control agents against *A. frontella*.

From the responses to a questionnaire sent to entomology cooperators in 18 eastern states it has been determined that Massachusetts constantly suffers the most severe damage from the alfalfa blotch leafminer, *Agromyza frontella* (Rondani). However, in Berkshire County, Connecticut, on June 14, 1971, 58% of the alfalfa leaflets were damaged by *A. frontella* larvae. Also, in 1969–70, *Agromyza* sp., probably *A. frontella*, caused a loss of about 10% of the alfalfa crop, a pecuniary loss of about \$9/acre involving the first and second cuttings in Connecticut (Anonymous, 1972).

Although *A. frontella* is widespread in Europe (Spencer, 1973), it is not economically important there; perhaps because it is held in check by natural enemies. Therefore, since April 1973, the European Parasite Laboratory has been engaged in field and laboratory studies of the agromyzids *A. frontella*, *A. nana* Meigen and *Liriomyza congesta* (Becker) and their natural enemies. Total parasitism of *Agromyza frontella* by the diverse parasitoids frequently ranged from 70 to 90%. Several of these parasitoids are being considered for introduction into the United States as biocontrol agents against this pest. To date, the following species of parasitoids of the agromyzids, *A. frontella*, *A. nana* and *Liriomyza congesta*, have been recovered during the studies in Europe: (Braconidae) *Opius durescaui* Fischer, *O. propodealis* Fischer, *Phanomeris braconius* (Haliday); (Eulophidae) *Chrysocharis* ? *nitetus* (Walker), *Cirrospilus vittatus* Walker, *Dacnusa dryas* (Nixon), *Diglyphus isaca* (Walker), *Pnigalio* sp.,

¹ Mention of a proprietary product in this paper does not constitute an endorsement by the USDA.

² USDA, ARS, NER, PGGI, Vegetable Laboratory Building 470, Agricultural Research Center East, Beltsville, Maryland 20705.

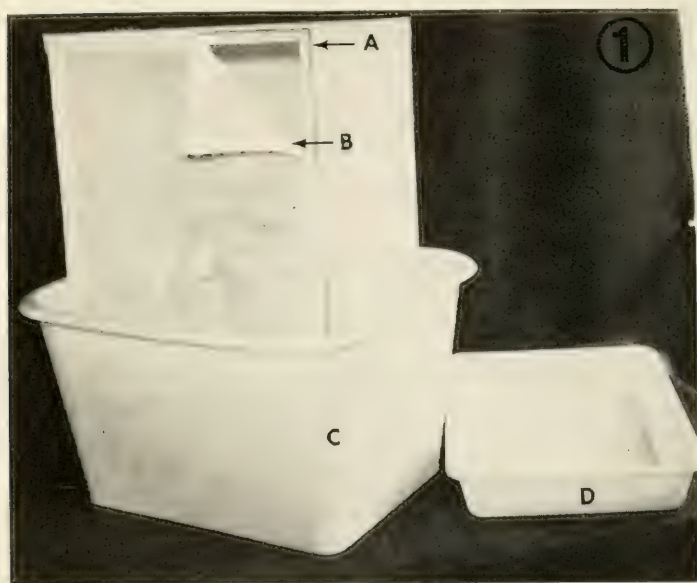


Fig. 1. Rearing cage. A, hook-equipped side of Velcro strip. B, eye-equipped side of Velcro strip. C, large cage bottom. D, small cage bottom.

"*Tetrastichus*" sp.; (Pteromalidae) *Miscogaster* ? *masculata*, ?*M.* sp., *Systasis* sp. and ?*Trichomalus*.

Two ectoparasitoids, *Phanomeris braconius* and *Diglyphus isaea*, and the endoparasitoids, *Opius propodealis* and *Dacnusa dryas*, have all been reared through several generations on *Agromyza frontella*. *Phanomeris braconius* was released in the US in the spring of 1974. *Diglyphus isaea* and *Opius duresseui*, a new species (Fischer, 1975), are presently being reared at the USDA Beneficial Insects Research Laboratory, Newark, Delaware, for spring and summer release in 1975-76. The taxonomy of *Agromyza frontella* was studied by Steyskal (1972) and Spencer (1973). However, little was known about the biology of the pest. The present paper summarizes the results of the laboratory studies made at the European Parasite Laboratory on the biology of this pest.

MATERIALS AND METHODS

The basic cage used in rearing *A. frontella* was a rectangular frame ($40 \times 25 \times 42$ cm) of wooden strips (1.5×1.5 cm) covered on 5 sides with fine mesh Velcro® attached to the strips with neoprene base glue. Access to the cage was provided by sewing the eye-equipped side of a strip of Velcro® to 2 or more edges of 1 face of the frame and gluing the hook-equipped strip to the

appropriate wooden strips (Fig. 1A, 1B). Two sizes of plastic containers (ID $50 \times 38 \times 29$ cm, and $45 \times 30 \times 6.5$ cm) held the alfalfa plants and served as the cage bottom (Fig. 1C, 1D).

Alfalfa plants (Europe variety) used in the study were grown in the laboratory in terra cotta pots (diam 16×22 cm) in a mixture of 50% garden soil, 25% peat, and 25% vermiculite. In tests requiring a self-sustaining ecosystem throughout the test period, the pots were placed in the large containers. For convenience, when such an environment was not necessary, the pots were placed in the small containers. Vermiculite was poured into the container until it was level with the upper edge of the terra cotta pots. A layer of sifted, fine, white sand was then poured onto the vermiculite and the soil of the plant to a depth of about 1.5 cm to retain moisture and to facilitate the recovery of dead flies at the end of a test period.

The assembled cage containing insects was placed inside a semi-programmed test chamber maintained at $22.2 \pm 1.5^\circ\text{C}$ and $60 \pm 5\%$ RH during the 18-h photophase and at $17 \pm 0^\circ\text{C}$ and $65 \pm 5\%$ during the 6-h scotophase. Between 0830 and 1700 h each day at about 2-h intervals, the temperature was first lowered and then raised by 3°C for 15 min. Also, the cages were rotated 90° at 2-h intervals. An oscillating fan (height 50 cm and diameter 30 cm) was placed about 1 m from the cages to agitate the alfalfa leaflets.

Four to 5 days after the 1st mines became visible on alfalfa leaflets, mined leaflets were removed and placed in individual petri dishes (50×12 cm) on slightly moist sand. However, field observations subsequently showed that mature fly larvae placed in plastic bags often left the mines immediately if the temperature was raised $4\text{--}5^\circ\text{C}$ above ambient and formed puparia within an hour after cutting out of the mines. Therefore, mined leaflets were removed the 6th day after mines became visible and were placed in transparent plastic bags. The mature larvae and puparia that were recovered in this way were placed in petri dishes in groups of 10. The petri dishes were placed in the control chamber and held for adult emergence.

For the oviposition and longevity studies, the adult flies were put into pint cardboard cartons with bottoms of nylon cloth, and which contained a pipe cleaner support (Fig. 2). Honey was dabbed onto the nylon cloth and a moistened sponge covered with a petri dish was placed over the nylon. Also a pipe cleaner dabbed with droplets of honey and moistened was inside the cartons. The cartons were held at room temperature, placed in the control chamber or held in a refrigerator at $4.4\text{--}7^\circ\text{C}$.

RESULTS

Agromyza frontella females from one to ten days old oviposited immediately when they were exposed to alfalfa. The ovipositor was inserted a short distance into the under surface of a leaflet without puncturing the upper surface. The deposited egg (0.35 mm long, Fig. 3) was usually found toward the base and near a border. Oviposition scars were smaller and less easily seen than scars caused by adult feeding; though both kinds of scars were made with the ovipositor.

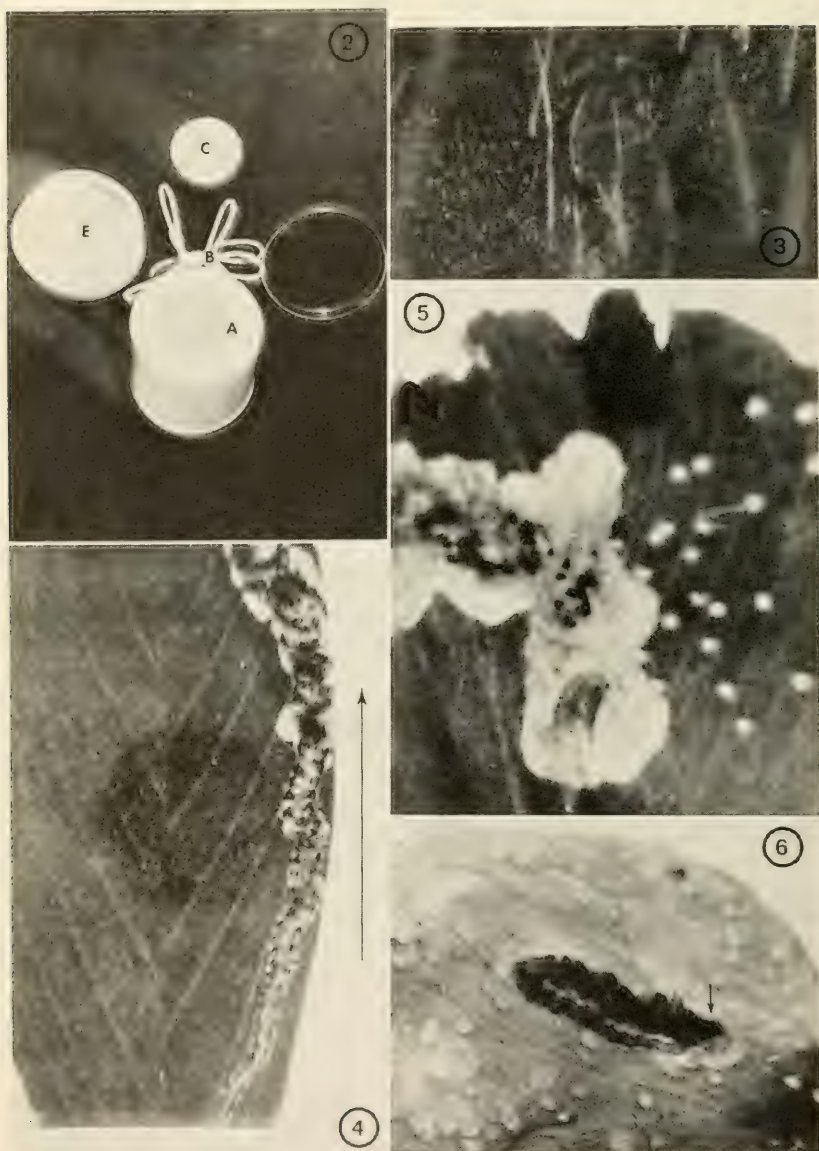


Fig. 2. Pint cardboard carton used for oviposition and longevity studies. A, tergal cloth bottom. B, pipe cleaner. C, sponge. D, petri dish. E, top of cardboard carton. Fig. 3. Egg of *Agromyza frontella*, 0.35 mm long, inside mine, on under surface of alfalfa leaflet. Fig. 4. Early stage of typical *A. frontella* mine. Arrow indicates direction of mining from base toward apex of alfalfa leaflet. Fig. 5. Late stage of typical *A. frontella* mine. Note blotch in center of leaflet and the mature larva within the mine. Fig. 6. Dead *A. frontella* larva inside mine on leaflet fed on heavily. Note bleached area surrounding dead larva.

At our laboratory conditions, the eggs hatched five to six days after oviposition. Newly emerged larvae always began mining from the point of oviposition toward the leaf border (Fig. 4), continued along the border of the leaf and toward the apex and then turned inward toward the center. The mine was broadened gradually until both sides of the center vein of the leaflets were consumed (Fig. 5). The larvae cut their way out of mines five to six days after the mines became visible. Within one to several hours, the cuticle of the mature larvae shrank in length, hardened and rounded to form typical cyclorhaphous, dipterous puparia. An additional 20–23 days were required for larval/pupal metamorphosis and adult emergence in the laboratory.

Adult flies emerged from the puparia by splitting them along lines of weakness situated laterally on the cephalic extremity. Shortly after emergence the adult flies distended their wings and darkened in color. If water and honey were available immediately after emergence, flies kept in pint cartons at 4.4–7°C lived as long as 15 days if the cartons were removed from the refrigerator each day, dabbed with honey, sprayed with water from an atomizer, and held at room temperature for 1 h. The longevity of flies in the rearing cages did not differ significantly from the longevity of flies kept in the oviposition cartons.

In cages with high populations (40 flies/400–500 leaflets), adult flies often destroyed entire plants by puncturing the leaflets with the ovipositor and feeding on the juice. As a result, the leaflets became brittle and bleached. Hasan (1971) reported similar damage caused by field populations of a carrot miner *Napomyza carotae* Spencer, feeding on carrot leaves in North Wurttemberg, West Germany. The *Agromyza frontella* larvae were never able to complete their development in areas of alfalfa leaflets that were fed on heavily by the adults (Fig. 6).

No mating was observed during our studies though males and females of varying ages were observed in pint cardboard cartons, glass tubes and oviposition cages on numerous occasions for as long as a half hour. Nevertheless, after five generations, the ratio of females to males remained constant at about 1:1 in the subsamples examined. I assume, therefore, that mating occurred in the oviposition cages on the underside of the slightly curled alfalfa leaflets. In addition, from the number of oviposition scars and the ratio of females to males in several tests, both oviposition and mating were stimulated by alternately raising and lowering the temperature four times a day and by continuously agitating the alfalfa leaflets by the air current from the oscillating fan. The frequencies of oviposition scars and mating (based on sex ratio) were lower in cages not exposed to these conditions.

DISCUSSION AND CONCLUSION

Although this study showed that *A. frontella* is an acceptable host for the rearing of several species of natural enemies of agromyzids, the field bionomics of this pest and its natural enemies require further study in order to select and give priority to those parasitoid species most likely to reduce the damage caused by this pest in the US to a noneconomic level of importance.

Indicative of the need for further field studies is the fact that Spencer (1973) stated that no information on the rate of parasitism of this pest by its natural enemies was available. Of the four major parasitoids included in the present study, Spencer listed only *Dacnusa dryas* as having been recovered from *Agromyza frontella*. The number of field generations of *A. frontella* per year has not been clearly established. Spencer (1973) reported that there were at least two generations between June and September. However, in the Paris area, mature *A. frontella* larvae were collected as early as Apr. 10 in 1973 and 1974, and as late as Sept. 14 in Luxembourg and near Trier, Germany, in the same years. From the laboratory and field observations reported here, *A. frontella* in warm climates probably has from five to six generations/year.

Given the high percentage of parasitism by its natural enemies and its low level of economic importance in Europe, it seems likely that the importation into the United States of selected parasitoids will reduce considerably the damage caused by *A. frontella* in the eastern US.

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TABANIDAE (DIPTERA) OF TEXAS.
VI. COASTAL PRAIRIE SPECIES, VICTORIA COUNTY

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ABSTRACT—Coastal prairies some thirty mi inland from the Gulf of Mexico produced fourteen species of Tabanidae in three genera, these represented by 1,212 females and 4 males, in the period March 18–October 8. Four species included 87.9% of the material taken. In decreasing order of abundance these were *Tabanus subsimilis* Bellardi, *T. mularis* Stone, *T. quaesitus* Stone, and *T. sulcifrons* Macquart. The modified Animal Trap collected twice the numbers of *T. mularis* taken by three Manitoba Traps in different locations. The coastal prairie fauna was very similar to that taken in coastal marshes near Galveston; ten species were common to both ecosystems, seven of these being large *Tabanus* spp.

A previous survey of the Gulf Coastal Plain Tabanidae in Texas considered species found in the marshes of West Galveston Bay (Thompson, 1973). That study emphasized description of the fauna, including their relative abundance, seasonal distribution, and response to several trap types. The present study was conducted to obtain the same information for those species found inland in the prairies of the Gulf Coast.

TEXAS COASTAL PRAIRIES

Victoria County is located in southeast Texas between Corpus Christi and Houston some 30 mi inland from the Gulf. The geological formations occur in a broad belt of Pleistocene strata (Houston group) some 30–40 mi wide paralleling the coast (Thompson, 1973) and underlain by oil fields. This rolling country is intersected by many streams draining into the Guadalupe River which originates in the Hill Country to the northwest and then traverses Victoria County and the Coastal Plain to end in San Antonio Bay and the Gulf. The geology, physiography, and climate belong to the coast but biologically this region is one of transition between the coastal prairies and the Post Oak Belt north of it and the South Texas Plains of thorny brush country to the south. The prairies of Victoria County lie within the southern end of the Texan Biotic Province, itself a giant ecotone of central Texas between the Austroriparian (forest) and Sonoran (grassland) biotas east and west of it, and within the northern extremities in distribution of several subtropical animals known here now or in the recent past—the pygmy mouse, the jaguar, and the ocelot (Blair, 1950). The Tamaulipan flora of the thorny brush joins the prairies and oak-hickory alternes of the Texan here through northward extensions of mesquites, huisache and related acacias, and prickly pear cacti. Alluvium along the Guadalupe floodplain supports mesic forests of oaks, hackberries and pecans. Victoria, the

county seat, is 200 ft above sea level. The climate is coastal, like that of Galveston, but is less humid and produces slightly warmer summers and cooler winters. Victoria also has less rain (8-10 in less annually).

STUDY AREA AND METHODS

The study area was located some 8 mi NE of Victoria on Garcitas Creek and nearby pastures. Collections were made using modified Manitoba Traps and Animal Traps (Thompson, 1969; modified, Thompson and Gregg 1974) which were operated continuously from March 18 through October 8. Catches were picked up weekly. No carbon dioxide or other attractant was used. Three Manitoba Traps were operated, one on the bank of Garcitas Creek and two traps in open pastures in the vicinity which contained cattle throughout the study. One Animal Trap was erected in an open pasture. All traps were fenced to protect them from cattle.

THE FAUNA

Fourteen species in three genera were collected, these represented by 1,212 females and 4 males (Table 1.). The four species predominating included 87.9% of the material taken.

Phenology: The season of appearance and peak collection date are shown in Table 1. Collection of *Tabanus quaesitus* Stone (19 specimens) and *T. subsimilis* Bellardi (3 specimens) on the first date the traps were serviced showed that these species were present earlier in March. The latter species was the most abundant dominant present and the only form found throughout the entire season, following a pattern of seasonal distribution described for other areas of southeast Texas (Thompson, 1976).

Notes on collection: *Silvius* was represented only in the Garcitas Creek trap (3 specimens) and was not taken in collections from the pasture sites. *Tabanus subsimilis* was also taken in greater numbers in the creek bed (25.5-66%) than in Manitoba Traps at the two pasture sites. The one Animal Trap used produced twice the total of *T. mularis* Stone specimens taken by three Manitoba Traps in different locations. This finding substantiates the specificity of *T. mularis* for the Animal Trap, an attribute previously described for other members of the *Tabanus nigrovittatus-quinquevittatus* complex (Thompson and Gregg, 1974). The potential of this trap for collecting *Tabanus abdominalis* F., *T. cymatophorus* Osten Sacken, and *T. proximus* Walker was not observed at West Bay.

Comparison of coastal faunas: Fourteen species were collected in the prairies of the Victoria County study area while twenty were taken at West Bay marshes (Thompson, 1973). The faunas were very similar, excluding the six species closely associated with coastal marshes and probably breeding only there (*Tabanus acutus* (Bigot),

Table 1. Tabanidae (females) taken 8 mi NE Victoria, Victoria Co., TX, 1974.

Species	Manitoba Traps (3)	Animal Traps (1)	Grand Total	Seasonal Range (Peak)
<i>Silvius quadrivittatus</i> (Say) ^a	3		3	May 29
<i>Chrysops</i>				
<i>callidus</i> Osten Sacken ^a	1		1	Apr 3
<i>flavidus</i> Wiedemann ^{a,b}	3		3	Apr 17-Jul 24
<i>Tabanus</i>				
<i>abdominalis</i> F. ^{a,b}	15	14	29	Jun 19-Jul 24 (Jul 17)
<i>americanus</i> Forster ^b	8		8	Jun 5-Jul 10 (Jun 19)
<i>atratus</i> F. ^{b,c}	2	1	3	May 1-Jun 12
<i>cymatophorus</i> Osten Sacken ^b	13	31	44	Jun 12-Aug 23 (Jul 31)
<i>mularis</i> Stone ^b	21	268	289	Apr 17-Oct 8 (Jun 5)
<i>proximus</i> Walker ^{a,b}	22	25	47	May 22-Aug 16 (Jul 24)
<i>quaesitus</i> Stone ^a	146	3	149	Mar 27-Apr 24 (Apr 3)
<i>stygius</i> Say ^b	1		1	Jun 5
<i>subsimilis</i> Bellardi ^{b,c}	511	29	540	Mar 27-Oct 8 (Apr 17)
<i>sulcifrons</i> Macquart ^b	80	8	88	Jun 19-Oct 8 (Jul 17)
<i>venustus</i> Osten Sacken		7	7	Apr 24-Jun 5 (May 22)

^a Victoria County record.^b Represented at West Galveston Bay, Brazoria Co., 1971. Week of peak abundance that of highest 3-sample running average (noted for most species).^c Represented by 1-3 male specimens.

T. cadsi Philip, *T. lineola* var. *hinellus* Philip, *T. nigrovittatus* Macquart, *T. nigrovittatus* var. *fulvilineis* Philip, and *T. texanus* Hine). Ten species were common to both study areas, most of these being large *Tabanus* spp. Both faunas were characterized by numerous individuals of these large species and by very large numbers of smaller forms. *Tabanus subsimilis* predominated at both marsh and prairie. *Tabanus mularis* was much more numerous inland. *Tabanus quaesitus* was not taken at West Bay. This species has not been reported in such large numbers from one location at one time. *Tabanus quaesitus* is an early spring form frequent in other areas of southeast Texas and recent Malaise Trap collections with carbon dioxide show that it is very numerous in some of these localities (Thompson, unpublished). Of the seven large species of horse flies common to both ecosystems, *Tabanus stygius* Say and *T. sulcifrons* Macquart were much more numerous in the West Bay marshes.

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BOOK REVIEW

EVOLUTION OF INSTINCT. COMPARATIVE ETHOLOGY OF HYMENOPTERA. 1976. K. Iwata. Available from National Technical Information Service, U.S. Department of Commerce, Springfield, Va., 22161 as PB 257052, \$13.00 cloth, \$3.00 microfiche.

The translation of Kunio Iwata's "Evolution of Instinct. Comparative Ethology of Hymenoptera" from Japanese into English unveils a wealth of information on the behavior of wasps and bees which was heretofore unavailable to the vast majority of hymenopterologists and insect behaviorists. Iwata's book combines his own observations and insights with those of other workers obtained via a rather extensive literature search. The progression of chapters more or less follows logically the current phylogeny of the Hymenoptera and culminates in a summary chapter entitled "Comparative Ethology of Aculeata." Some chapters are more thoroughly treated than others and reflect Iwata's background and interest; thus, this book is slanted more toward wasp behavior than bee behavior.

Although K. V. Krombein in his "Foreword" refers to "numerous detailed illustrations" in Iwata's book, only Chapters 7 (Ground-burrowing wasps) and 10 (Wasps that use plastic materials) are sufficiently illustrated. A mere 50 figures accompany the nearly 500 pages of text and, in some cases, the textual references to these figures are either vague or lacking. Chapter 1, which introduces the "Functional modification of the ovipositor," albeit brief, does not contain a single figure. In this chapter, comparative diagrams of the various kinds of hymenopterous ovipositors would have been meaningful. The 43 tables, on the other hand, are more than sufficient and contain much pertinent behavioral and ecological information. Some tables are, however, superfluous or unnecessary. Iwata's abbreviated formulae for prey families in the tables are cumbersome in that the reader must refer continually to the text. An index entitled "Important Genera of Hymenoptera" is helpful, but the absence of a general subject index makes a comparison of chapter topics time-consuming and difficult.

Iwata interweaves his observations with those of other workers in a factually straightforward yet interesting manner. Each chapter contains a number of significant points in the form of "lead" or summary sentences which serve as points of reference and/or orientation. Such an example is the last sentence of the first paragraph in Chapter 8 where Iwata points out that only small wasps can nest in living plant stems because of the limitations of the diameter of the pith. Iwata's discussion of the evolution of the Terebrantia and the transitional pathways leading to and including the Aculeata, continual references to primitive types of prey in relation to primitive groups of wasps, connection of nesting sequence and nest-type in the Pepsinae and Pompilinae (Pompilidae), and the confirmation that hunting wasps are better "ecologists" than "taxonomists" are the result of much assimilation and association. His exemplifications of a variety of evolutionary phenomena such as the convergent morphology and nesting behavior of *Palarus* (Larrinae) and the Philanthinae give this book a refreshing slant. Iwata never hesitates to incorporate ecological and physiological information with strictly behavioral data, e.g., species of *Ammophila*

(Sphecidae) which prey upon either lepidopterous or sawfly larvae locate the prey by means of their fecal pellets on the ground beneath plants.

Iwata's acceptance of and reliance upon the conclusions of other workers in this field serve to reinforce the solidarity of this book. His presentation of behavioral information in Chapter 7 in an orderly sequence following Evans' phylogeny based upon the morphology of sphecid larvae is progressive. Iwata's continual referrals to prospective avenues of research such as the sequence and periodicity of oviposition and the components of behavior inside the nest should serve to stimulate their study by future hymenopterologists.

Some of the deficiencies of this book whether involving entire concepts, ideas or single words, appear to be translational ones, i.e., the original intent has been lost in the translation from Japanese to English. The use of the term "plastic" materials, although rather appropriate and encompassing, has other connotations, especially in this day and age. Iwata's ambivalent usages of the terms "parasite," "parasitoid" and "predatoid" may be questioned by contemporary animal ecologists. His term "possessive instinct" is misleading and his use of "sand wasps" early in the text conflicts with its current usage for the Nyssoninae as applied by Evans (1966). Later, Iwata corrects this misconception. Some sentences have an obviously skewed meaning such as "Spiders have made some important contributions to the development of the nest building habit of Aculeata." Generalizations such as "All . . . hunting wasps render the prey permanently paralyzed" and ". . . burrows do not have any specific pattern for a particular genus" detract from the soundness of the book. Other errors such as "Wasps . . . sting . . . between the *mandibles*" of the spider, and, ". . . all . . . *Lyroda* . . . hunt for *shorthorned grasshoppers*," may be the result of the translation. Some of Iwata's theora are questionable, e.g., "insects of large size usually have primitive features and are represented only by a *few* species." What about *Pepsis*?

Iwata's inclusion of ethological data for the genera *Palarus* (Larrinae) and *Mellinus* (Mellinae) in Table 14 is puzzling in view of their phylogenetic distinctness. Similarly, placing *Palarus* (Larrinae) between *Aphilanthops* and *Trachypus* (both Philanthinae) in the text is illogical based upon their phylogenetic positions even though all three groups prey upon Hymenoptera.

Iwata could have speculated more on the evolution of various behavioral components or patterns, e.g., the evolution of plant-nesters from ground-nesters or vice-versa in such groups as the Pemphredoninae and Crabroninae. His failure to associate *deep* multicellular and *shallow* unicellular nests in relation to energy consumption weakens mediocre sections on nest architecture and dimensions. Iwata's continual references to specific names without referral to the appropriate genera provide obstacles in following the text. Although having been utilized for one-third of a century, Iwata's formulae for behavior patterns, e.g., FVOV, are confusing and difficult to utilize.

Despite the deficiencies outlined in the preceding paragraphs, Iwata's "Evolution of Instinct. Comparative Ethology of Hymenoptera" is a monumental contribution to the field of comparative behavior. It should stand as the "Bible" of Hymenoptera ethology for some time because of the vast storehouse and assimilation of information contained therein.

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NOTE

LECTOTYPE DESIGNATION FOR GLYPOTHIRIPS ARKANSANUS
HOOD (THYSANOPTERA: PHILAEOTHIRIPIDAE)

J. D. Hood erected about 1050 species-group names in the Thysanoptera. Most of these referred to species described by him from specimens that were retained in his collection. When this collection, which comprised about 60,000 slides, was accessioned by the United States National Museum of Natural History (USNM) in 1964, most of the identified specimens were arranged systematically, and most of the unworked specimens were in numerical order. The systematic collection is being incorporated into the previous USNM holdings, which are also systematically arranged. However, Hood's numerical collection includes about 3,000 slides that lack data labels, bearing only numbers that correspond to numbered data cards. Hood often affixed the original collector's labels to these cards and sometimes added his own notes. Although chiefly unworked, the unlabelled slides include type-series of several species described between 1957 and 1960.

During the course of revisionary studies on the genera of the Glyptothripini, Mound was unable to find the type-series of *Glyptothrips arkansanus* Hood (1957, Proc. Biol. Soc. Wash. 70:59-60) in the systematic collection. However, specimens in 4 series of unlabelled slides in the numerical collection were identified as *arkansanus* from the description. The Hood numbers, data, and the number of specimens for these series are as follows: 2757 Arkansas, Fayetteville, "5.3.57", broomsedge, coll. Whitcomb, 1 ♀; 2759 Arkansas, Fayetteville, 16 March 1957, broomsedge, coll. Whitcomb, 1 ♀; 2764 Arkansas, Fayetteville, 16 March 1957, broomsedge, coll. Whitcomb, 9 ♀ 2 ♂; 2765 Arkansas, Fayetteville, 16 March 1957, sedge grass, coll. Whitcomb, 18 ♀ 1 ♂.

The data for these specimens (29 ♀, 3 ♂) contrast with the published data for *G. arkansanus*: Arkansas, Stillwater, 16 March 1957, 29 ♀ including the holotype, 2 ♂, from *Andropogon virginicus* (coll. Willard H. Whitcomb). Whitcomb (personal communication) indicated that both broomsedge and sedge grass referred to *Andropogon virginicus*, and moreover that the published locality should have been Fayetteville not Stillwater. There can be little doubt that the specimens detailed above comprise the type-series of *G. arkansanus*. As no holotype was selected, the female at the head of series 2764 is hereby designated lectotype, and the other 28 ♀, 3 ♂ specimens are designated paralectotypes. The corrected data for this lectotype, which was labelled accordingly, are as follows: Arkansas, Fayetteville, 16 March 1957, ♀ macroptera on *Andropogon virginicus*, W. H. Whitcomb, USNM Type No. 71993.

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NOTE

ECOLOGY AND BEHAVIOR OF SOME PANAMANIAN ODONATA

Some species of dragonflies that breed only in small temporary pools of water during the rainy season use a form of reproductive aestivation for survival during the dry season, when no breeding habitat is available. *Erythrodiplax funerea* move into forested areas during November and remain in a teneral stage until the first heavy rains in May. They then attain adult coloration rapidly and emigrate to open areas with small pools. The coloration during the dry season remains dull brown and individuals perch on or near the ground in close association with little or no aggressive interactions. Within three days after the onset of rains, their bodies become black and they acquire distinctive black wing patches.

In another study, species of *Hetaerina* damselflies (*H. macropus*, *caja*, *miniata*, and *fuscoguttata*), which co-occur on lowland streams were individually marked and recaptured during a six week period at four study areas, each on separate streams. Behavioral and ecological observations were undertaken to answer questions about the competitive relations between these species. *Hetaerina macropus* and *H. caja* occurred only on sunlit portions of the streams while *H. miniata* and *H. fuscoguttata* occurred only on shady forested portions. The apical tip of the wings of males were red in *miniata* and *caja* and brown in *macropus* and *fuscoguttata*, thus the pair of species in shady and in sunlit areas of the streams have contrasting wing tip coloration in each case, which may reduce interspecific aggressive interactions. Another behavior studied, Circle Flights, is used during territorial encounters between males. Each species was found to have a distinctive Circle Flight pattern such that when interspecific chases occurred, the differences in Circle Flight pattern rapidly dissociated the individuals. Predation from lycosid spiders was great if, during intraspecific Circle Flight encounters, the chasing individual caught up to the one being chased for they would invariably fall to the ground. Selection from predation should result in ritualized threat behavior replacing actual fighting in these species.

Territorial behavior differed between the species occupying sunlit areas and those occupying dark areas. The sunlit species remained on the territories throughout sunny portions of the day while the dark area species frequently left their territories to feed in the canopy of the forest bordering the stream. It is hypothesized that the species with territories in dark areas cannot feed efficiently there because of low light intensity. This has resulted in a higher number of aggressive encounters observed in the dark area species because of the instability of territorial possession there.

EUGENE S. MORTON, *Division of Zoological Research, National Zoological Park, Smithsonian Institution, Washington, D.C. 20009.*

BOOK NOTICE

Butterflies of West Malaysia and Singapore. 1975. By W. A. Fleming. Vol. 1: 64 pp., 54 pls. (479 figs.), Vol. 11: 93 pp., 36 pls. (1120 figs.) Published by Classey Publications, England. Distributed in North America by Entomological Reprint Specialists, P.O. Box 77971, Dockweiler Sta., Los Angeles, Calif. 90007. \$47.00 per set of 2 vols.

This two-volume work is a high quality handbook which emphasizes the recognition of butterflies by the use of colored photographs. All of the approximately 1,000 species occurring on the Malay Peninsula from the Southern border of Thailand to and including Singapore are illustrated, in most cases by showing both upper and lower wing surfaces.

The 13-page introduction is duplicated in each volume. It supplies basic information on morphology and nomenclature, the necessary explanation of the plate legends, 3 maps, and a glossary of terms. The main text is organized by families with the species in a presumably natural order; each species is represented by scientific name, plate legend, length of front wing, abbreviations indicating the chief distribution within the area, a few salient recognition characters, and for some species an indication of the degree of rarity. No common names are used; it is said that for so rich a fauna they would likely be confusing. Incidentally, HesperIIDae (skippers) are regarded as butterflies.

The butterfly photographs, which are mainly of excellent quality, were made in Malaysia and Britain. If the scientific name of each species had appeared on the plates (perhaps a costly addition) instead of in legends alone, it would have been a useful convenience.

The author, W. A. Fleming, is a Scot who came to Malaysia in 1937 and became a planter in Selangor after imprisonment during World War II. He describes himself as a collector, not an entomologist. Professional entomologists could take pride in the work of more collectors if those collectors had Fleming's evident deep interest and scholarly qualifications.

ASHLEY B. GURNEY, *Resident Cooperating Scientist, Systematic Entomology Laboratory, IIBIII, Agr. Res. Serv., USDA, c/o U.S. National Museum, Washington, D.C. 20560.*



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STUDIES ON THE GENUS *APHODIUS* OF THE UNITED
STATES AND CANADA (COLEOPTERA: SCARABAEIDAE):
VI. TWO NEW SAND ASSOCIATED SPECIES
FROM COLORADO AND UTAH

Robert D. Gordon

Abstract.—Horn's Series I-c of *Aphodius* is discussed and a key to the pale, fimbriate members of the Series provided. Two new species are described, *aggregatus* and *perfimbratus*. Both are apparently sand-loving, and both probably feed on detritus in the sand.

Many species in several aphodiine genera are sand-loving, but very few of these are in the genus *Aphodius*. When knowledge of the habits of more species of *Aphodius* is available, this statement may no longer be true, but the only previously described species known definitely to be associated with areas of relatively unstable sand (Atlantic coastal dunes) is *A. phaleroides* Horn. It is perhaps no coincidence that the two new species described here are morphologically similar to *phaleroides*.

Horn (1887) established his series I-c for 11 species of *Aphodius*, including *phaleroides*, and 11 more species have been added by various authors from 1887 to the present. I am assigning both new species to this series because of their apparent relationship to *phaleroides*. The Series I-c is a heterogenous assemblage of several phyletic lineages, and it is obvious that new groups will have to be established and species reassigned in a subsequent paper. For the present I am modifying Horn's 1887 key to include all of the species of series I-c that are mostly pale yellow and lack clypeal armature. This is possible because *phaleroides* and allies are strikingly pale compared to the rest of the species in the key and are fimbriate with hairs on the pronotal and clytral borders. The following key begins with couplet 7, from page 36 of Horn, 1887; *parvus* Horn is omitted as it has previously been transferred to *Didactylia*, and *aegrotus* Horn has been placed in series I-b by Cartwright (1939) as *geomysi* Cartwright, later treated as a junior synonym of *aegrotus* by Woodruff (1973).

Specimens used in this study are the property of the following institutions (abbreviations for each as used herein are indicated): Canadian National Collection, Ottawa (CNC); H. Howden collection, Carleton University, Ottawa (HH); U.S. National Museum, Washington, D.C. (USNM).

Modified Key to Some Species of Series I-c

- | | |
|--|----------------------|
| 7. Elytral intervals 9 and 10 pubescent | <i>bifrons</i> Bates |
| – Elytral intervals 9 and 10 not pubescent | 8 |

8. Lateral borders of pronotum and elytra fringed with hairs longer than scutellum; basal border of pronotum without marginal line (Fig. 2) *perfimbriatus*, n. sp.
- Lateral borders of pronotum and elytra fringed with hairs shorter than scutellum; basal border of pronotum with marginal line (Fig. 1) 9
9. Discal area of pronotum with median, darkened area; Atlantic Coast *phaleroides* Horn
- Discal area of pronotum immaculate or with elongate, darkened area on each side of middle (Fig. 1); southern Utah *aggregatus*, n. sp.

Aphodius aggregatus Gordon, new species
(Figs. 1, 3, 4)

Holotype.—Male, length 4.38 mm, greatest width 2.00 mm. Form elongate, moderately convex, widest just posterior to middle of elytra (Fig. 1). Color pale brownish yellow except pronotum with 2 nebulous, longitudinal darkened areas on each side of middle; elytron with narrow sutural border dark brown and 2 elongate, nebulous, darkened areas, anterior area on 6th and 7th intervals posterior to humerus, posterior area on 3rd and 4th intervals posterior to middle of elytron. Head shining, lacking frontal tubercles; surface barely perceptibly alutaceous, finely punctate, punctures separated by about the diameter of a puncture; anterior border of clypeus distinctly reflexed, shallowly emarginate medially, anterolateral angle broadly rounded; gena fimbriate with hairs $\frac{1}{2}$ as long as apical segment of maxillary palpus. Pronotum shining, with no apparent surface microsculpture, strongly convex, punctate, punctures coarser than on head, separated by less than $2\times$ the diameter of a puncture; anterolateral angle rounded, lateral border distinctly margined, feebly curved throughout, fimbriate with hairs no longer than scutellum, posterolateral angle abruptly rounded, posterior border slightly sinuate, finely margined, fimbriate with hairs $\frac{1}{2}$ as long as scutellum. Elytra shining, fringed with hairs shorter than scutellum, intervals feebly alutaceous, slightly convex, with fine punctures arranged in 2 irregular rows; striae feebly impressed, punctures widely spaced, nearly invisible. Anterior tibia with outer teeth strong, posterior tooth basad of middle of tibia, apical spur strongly thickened, curved downward at apex; middle and hind tibiae with apex fringed with unequal spines, outer spur $\frac{2}{3}$ length of inner, curved at apex, inner spur longer than 1st tarsal segment, strongly sinuate. Front tarsus with basal segment shorter than segment 2, segments 2-4 subequal, segment 5 nearly as long as segments 2-4 combined; segment 5 equal to segments 3-4. Abdominal sterna distinctly hairy; pygidium triangular, hairy, strongly alutaceous. Genitalia short, robust, slightly flattened dorsoventrally (Figs. 3, 4).

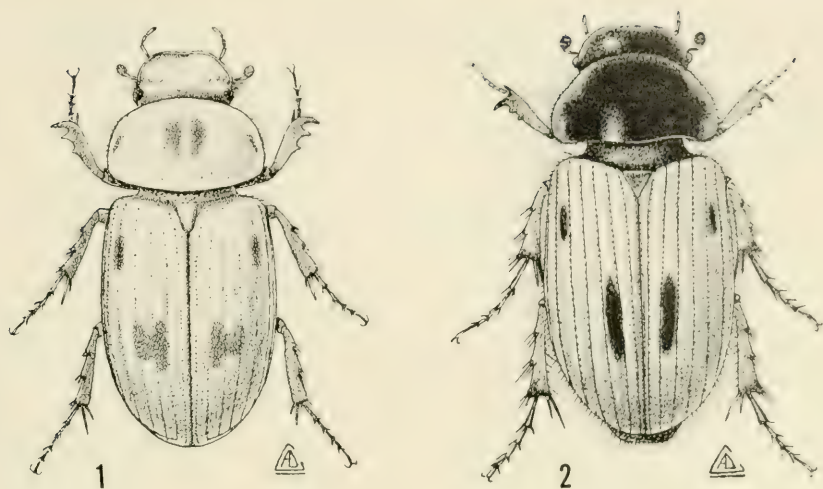


Fig. 1-2. Habitus. 1, *Aphodius aggregatus*. 2, *Aphodius perfimbriatus*.

Type-material.—Holotype, ♂, Utah, 14 mi S Hanksville, Fairview Ranch, 21-VII-1973, Robert Gordon, collected in sand-oak vicinity (USNM 73566). Paratypes, 98 ♂♂, with same data as holotype except: Collected in human dung, VII-9-1968, A. T. Howden; VII-28-1968, VIII-3-1968, VIII-7-9-1968, H. & A. Howden, light, Sand-Oak area. (CNC, III, USNM).

Variation.—Length ranges from 3.80 to 4.55 mm, width from 1.78 to 2.10 mm. The elytral spots vary from distinct and dark (Fig. 1) to indistinct, pale, reduced areas. The darkened pronotal areas range from distinct to nebulous.

Remarks.—*Aphodius aggregatus* is similar to *phaleroides* but *phaleroides* has the pronotum flattened dorsoventrally with a distinct, elongate, darkened area on the disc; head smooth, nearly impunctate; apical clypeal margin feebly emarginate appearing truncate; and length from 4.00 to 5.60 mm.

The type-locality is a sandy sagebrush desert area, and the specimens were collected along a dry, sandy wash lined with dwarf Gambel's Oak (*Quercus gambeli* Nutt.) ranging from a few inches to 6 feet in height. Approximately half the specimens were taken at human dung during a half hour period just before sunset. The beetles appeared suddenly, swarming over the bait, and just as suddenly disappeared. Other specimens came to black light after dark but no further activity was observed at the dung. All specimens collected are apparently males. Not all have been dissected but those that were are males, and I cannot detect any secondary

sexual dimorphism in the series. The closely related *phaleroides* occurs along the sandy Atlantic Coast beaches from New York to South Carolina. Both of these species are obviously associated with sand and are apparently saprophytic feeders.

Etymology.—The species name is a Latin adjective and refers to the aggregation of specimens observed at human dung.

Aphodius perfimbriatus Gordon, new species

(Figs. 2, 5, 6)

Holotype.—Male, length 4.60 mm, greatest width 2.25 mm. Form elongate, widest posterior to middle of elytra (Fig. 2). Color mostly pale yellow; head dark brown except apical and lateral borders slightly paler; pronotum dark brown medially, pale yellow laterally with median dark spot; elytron pale yellow with narrow sutural border dark brown and 2 small, dark-brown spots, anterior spot obliquely longitudinal on 6th and 7th intervals at basal $\frac{1}{3}$, posterior spot longitudinal on 3rd and 4th intervals just posterior to middle; ventral surface pale yellow except meso- and metasternum and abdomen dark brown. Head smooth, shining, entirely lacking frontal tubercles; surface feebly alutaceous except on vertex, finely punctate, punctures separated by less than to $3\times$ the diameter of a puncture; anterior border slightly reflexed, barely perceptible, emarginate medially, anterolateral angle broadly rounded; gena fimbriate with hairs as long as apical segment of maxillary palpus. Pronotum smooth, shining, with indistinct system of dual punctures, fine punctures separated by 2 to $4\times$ the diameter of a puncture, large punctures widely spaced, irregularly scattered throughout; anterolateral angle rounded, lateral border finely margined, straight, fimbriate with hairs longer than scutellum, posterolateral angle broadly rounded, posterior border sinuate, lacking margin, fimbriate with hairs shorter than scutellum. Elytron shining, intervals feebly alutaceous, slightly convex, with very fine, irregularly scattered punctures; striae feebly impressed, finely, indistinctly punctured, lateral border fimbriate with long hairs. Anterior tibia with outer teeth strong, posterior tooth basad of middle of tibia, apical spur short, laterally flattened, curved downward at apex; middle and hind tibiae with apex fringed with unequal spines, outer spur $\frac{2}{3}$ length of inner, slightly curved, apex acute, inner spur longer than 1st tarsal segment, strongly sinuate, apex acute. Front tarsus with basal segment shorter than segment 2, segments 2–4 subequal, segment 5 nearly as long as segments 2–4 combined; middle and hind tarsi with basal segment nearly as long as 2 and 3 combined, segments 2–4 subequal, segment 5 $1\frac{1}{2}\times$ as long as 4th. Abdominal sterna with long, semierect setae; pygidium triangular, with dense, long setae, setae particularly long on apical border. Genitalia long, slender, dorsoventrally flattened (Figs. 5, 6).

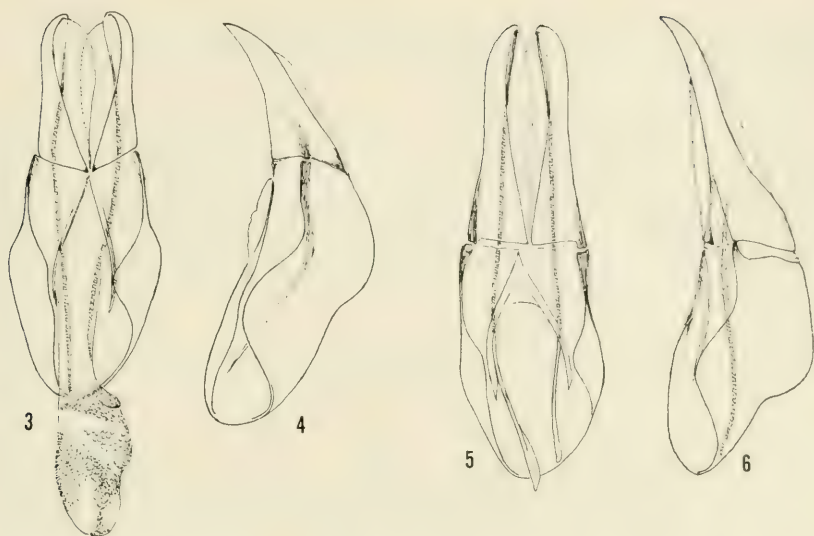


Fig. 3-6. Male genitalia. 3-4, *Aphodius aggregatus*, ventral and lateral views. 5-6, *Aphodius perfimbriatus*, ventral and lateral views.

Allotype.—Female, length 4.52 mm, greatest width 2.31 mm. Similar to male except pronotum narrower, more convex; anterior tibial spur slightly more slender and elongate.

Type-material.—Holotype, ♂, Colorado, Sand Dunes National Monument near Alamosa, 17-VII-1973, Robert Gordon (USNM 73567). Allotype female and 25 paratypes (14 ♂♂, 11 ♀♀) with same data. (CNC, HH, USNM).

Variation.—Length ranges from 3.80 to 4.60 mm, width from 1.98 to 2.31 mm. The dark elytral spots vary slightly in size and shape; the posterior spot may extend onto the 2nd interval and the anterior spot may be entirely lacking. Well-marked individuals have a faint dark spot on the 3rd and 4th intervals on the apical declivity of the elytron. The head often has pale circular areas on the front where the lateral tubercles would be if present, and the anterior border of the pronotum is also often pale.

Remarks.—Placement of this species in the existing classification is difficult because it possesses characteristics of both Series I-c and Group L. Horn's key to Groups (1887) separates Groups I and L on the basis of the presence or absence of elytral pubescence, a character which has no phyletic significance in this instance. Group L is reasonably homogeneous but Series I-c is made up of at least 3 distinct lineages. *Aphodius perfimbriatus* keys to Series I-c because it lacks elytral pubescence, and I provisionally place it there pending a complete reorganization of that Series. *Aphodius perfim-*

briatus most nearly resembles *phaleroides* and *aggregatus* from both of which it may be separated by the extremely long hairs on the elytral and pronotal margins.

All type-specimens were collected at black light at the edge of the dunes in Sand Dunes National Monument. The flight period began immediately after sunset and lasted about an hour. I believe *perfimbriatus*, as *phaleroides* and *aggregatus*, is associated with sand and is a saprophytic feeder. The color patterns of all three species, including the position of the darkened dorsal areas are extremely similar. I regard this as an independent adaptation to the habitat.

Etymology.—The species name is a Latin adjective and refers to the fringe of long hairs on the pronotum and elytra.

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Systematic Entomology Laboratory, IIBIII, Agric. Res. Serv., USDA, c/o U.S. National Museum, Washington, D.C. 20560.

EDITOR'S NOTE

The reader of this issue will notice the use of a new style in the layout of articles. We are now using a larger print size in the body of each article as well as more type/page. We hope that this will make the articles easier to read. This format should be less expensive to the Society and thus should allow for larger issues of the *Proceedings*. The Editor will be pleased to have your comments.

HEBETULA, A NEW GENUS OF THE PREDACEOUS MIDGE
TRIBE SPHAEROMIINI (DIPTERA: CERATOPOGONIDAE)

Willis W. Wirth and Margaret L. Debenham

Abstract.—*Hebetula*, new genus (type-species: *Mixohelea lemur* Debenham), is proposed for some Australasian and Ethiopian predaceous midges previously placed in *Mixohelea* Kieffer because of a nomenclatural procedure in which *Mixohelea* had been synonymized with *Xenohelea* Kieffer. A check list is presented for the 19 species of *Hebetula*.

In her recent revision of the Australian and New Guinean Ceratopogonidae of the tribes Heteromyiini and Sphaeromiini (Debenham, 1974), the junior author made the following statement (p. 18): "I have followed Wirth and Ratanaworabhan (personal communication) in assigning the Australian Region species formerly placed in *Xenohelea* to the genus *Mixohelea*. *Mixohelea* was placed in synonymy with *Xenohelea* by Macfie (1940), but Wirth and Ratanaworabhan have confirmed that the two are distinct, and the name *Xenohelea* should be applied only to those species with the thorax pollinose, and the fourth tarsomere cylindrical, and the batonets of the fifth tarsomere scattered along its length." This separation of *Mixohelea* and *Xenohelea* was published by Wirth, Ratanaworabhan and Blanton (1974, p. 610) in couplet 46 of their key to the genera of Ceratopogonidae.

When Kieffer erected the genus *Mixohelea* (1917b), he assigned to it five species, without designating a type-species: *Palpomyia polysticta* Kieffer, *P. pulchripes* Kieffer, and *P. roseiventris* Kieffer from India, *Sphaeromyias hexacantha* Kieffer from the Seychelles, and *M. australiensis* nom. nov. (for *Palpomyia imparunguis* Kieffer non Becker) from New Guinea. The first three of these species, according to Kieffer's descriptions, belong in *Xenohelea*, as based on the type-species, *X. pruinosa* Kieffer (by original designation), and as characterized by Wirth, Ratanaworabhan and Blanton (1974) in their key. The remaining two species, *hexacantha* and *australiensis*, key out to *Mixohelea* Kieffer.

However Wirth (1973) had previously selected as the type-species of *Mixohelea* one of the three Indian species, *pulchripes* (Kieffer), thereby sinking *Mixohelea* again into synonymy with *Xenohelea*. When he discovered the unfortunate results of this action, that volume of the *Catalog of the Diptera of the Oriental Region* was already in the press, and the action could not conveniently be changed. Now it is necessary to provide a new generic name for *hexacantha* (K.), *australiensis* (K.), and the other Australian and New Guinean species placed by Debenham (1974) in *Mixohelea*. For these species we propose the name *Hebetula* (Latin

hebes, -*etis* = dull, hence "little dull one"). We are grateful to Mr. George Steyskal of the Systematic Entomology Laboratory, USDA, for suggesting the form of the new generic name. Of the 19 known species of *Hebetula*, 17 are Australasian and 2 are Ethiopian, whereas of the 12 known species of *Xenohoelea*, 10 are Oriental and 2 are Ethiopian.

Hebetula Wirth and Debenham, new genus

Type-species, *Mixohoelea lemur* Debenham, 1974.

Mixohoelea Kieffer (in part), 1971b:364.

Mixohoelea sensu Debenham, 1974:16; Wirth, Ratanaworabhan, and Blanton, 1974:610.

Diagnosis.—The diagnosis is that of *Mixohoelea* sensu Debenham, 1974. *Hebetula* differs from *Xenohoelea* in lacking pollinosity on the thorax, in having the 4th tarsomere cordiform, and in having the batonnets restricted to the base of the 5th tarsomere in the female.

Included Species—all are new combinations

armiger (Debenham), 1974:20 (*Mixohoelea*). Queensland.

atypipennis (Tokunaga), 1966:127 (*Palpomyia*). West Irian.

australiensis (Kieffer), 1917b:364 (*Mixohoelea*; new name for *Palpomyia imparunguis* Kieffer which is preoccupied in *Palpomyia* by *imparunguis* Becker). New Guinea.

bequaerti (Goetghebuer), 1933:151 (*Palpomyia*). Congo.

bisulca (Debenham), 1974:24 (*Mixohoelea*). Western Australia.

centonis (Debenham), 1974:21 (*Mixohoelea*). Queensland.

gladiator (Debenham), 1974:24 (*Mixohoelea*). Australian Cap. Terr.

hexacantha (Kieffer), 1911:343 (*Sphaeromyias*). Seychelles.

infirmior (Debenham), 1974:28 (*Mixohoelea*). New South Wales.

latifrons (Debenham), 1974:29 (*Mixohoelea*). Queensland.

lemur (Debenham), 1974:32 (*Mixohoelea*). Western Australia.

luctus (Debenham), 1974:31 (*Mixohoelea*). New South Wales.

maai (Tokunaga), 1966:115 (*Xenohoelea*). West Irian.

muroides (Debenham), 1974:30 (*Mixohoelea*). New South Wales.

novaebritannica (Tokunaga), 1966:130 (*Palpomyia*). New Britain.

sarmensis (Tokunaga), 1966:116 (*Xenohoelea*). West Irian.

sensilis (Debenham), 1974:27 (*Mixohoelea*). New South Wales.

tonnoiri (Lee), 1948:66 (*Xenohoelea*). Tasmania.

versicolor (Debenham), 1974:35 (*Mixohoelea*). Western Australia.

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A 10-YEAR COLONY OF *ACROMYRMEX OCTOSPINOSUS*
(HYMENOPTERA: FORMICIDAE)

Neal A. Weber

Abstract.—A laboratory colony of *Acromyrmex octospinosus* Reich, a principal cutting ant of Central and Northern South America, has been maintained from the hour of capture of the newly fertilized female on 1 July 1965 in Trinidad until June 1976 when the last workers died. Two sister colonies from females of the same nuptial flight survived for lesser periods. In each case the isolated female disgorged the contents of her infrabuccal pocket, producing the nucleus for the future fungus garden on which her first eggs were laid. The resulting workers foraged for substrate for the rapidly growing garden. The ants of the 10-year colony (C of Weber, 1967) used 500 g of fresh substrate in 1966 to build a garden of 480 ml. By 1968 they were using 4,722 g substrate to build a garden of 6,100 ml. Monthly records of substrate used and garden size were maintained for 10 years. Female broods were produced first in one colony in 1967, then in this and a second (the 10-year colony) in 1968 and in all three 1969-1971, depending in part on the size of the garden attained. One colony had virgin females present in 1972 and in 1973 before the colony died. The virgin females frequently lost their wings and sometimes participated in substrate cutting. No male brood was produced. A fourth unrelated colony lived 11 years, producing female broods, and a fifth produced both male and female broods.

Weber (1967) described the development of three colonies of *Acromyrmex octospinosus* Reich, originated separately from single females fertilized on a nuptial flight in Trinidad on the morning of 1 July 1965. Each was maintained separately and the history of the resulting colonies (B, C, D) described for the first year. The present article summarizes the history of them and especially Colony C, that has survived for 10 years, including the unique monthly record of weight of substrate used by the ants and the corresponding monthly size of the fungus garden. Colony B died in March 1973 and Colony D in July 1974, after similar records of each were maintained. Colony D produced the first sexual brood in 1967, then all three developed female sexual broods starting with 1968 as described below. None produced males at any time.

Substrate Used

These colonies were among a large number of various attines that were kept at intervals in the laboratory at 25-27 C up to July 1974 (see also

Weber, 1976a, 1976b and 1977). During this period a variety of fresh substrate was given to this species, including rose leaves and flowers; flowering cherry and forsythia flowers, leaves of ash (*Fraxinus americana*), rhododendron, camelia. Succulents accepted included *Crassula arborescens*, *Graptopetalum paraguayense*, *Bryophyllum calycinum*, *Kalanchoe pinnata*, *Chamaecereus Silvestrii* and *Sedum Adolphii*. A particularly staple substrate was the pith (albedo) of grapefruit and orange (Fig. 10, Weber, 1972b shows Colony C). When the surviving colony was moved to Florida in August 1974, pecan, *Stachys floridana* and *Sambucus canadensis* were used.

The cutting of vegetation in nature for this species within 100 m of the original site of these colonies is described in Weber, 1972a, p. 78 ff. A distant view of the present colonies in the laboratory is Fig. 131, loc. cit. The natural history of this species in Trinidad is described in Weber (1945), based on a year of study in 1934-1935.

Rate of Cutting and Using Substrate

The rate of cutting fresh substrate and incorporating the sections into the fungus garden varied according to the size of the garden in the three colonies. This species, *Acromyrmex octospinosus*, however, has always been a rapid cutter of fresh green leaves and flowers whatever the colony. It often exceeds *Atta* in this regard, when considering garden volumes (Weber, 1972a).

Examples of rate of cutting forsythia flowers are taken from April 1967 records. Garden sizes on 25 April were 2,450 ml (B), 500 ml (C) and 3,350 ml (D). On 28 April, Colony B cut 10 g between 0910 and 1335 h, adding all to the garden and then was given an additional 10 g flowers that were added to the garden by 1533 h. Colony D used the same quantity but took longer. Colony B on 29 April took 10 g of forsythia flowers between 0850 and 1124 h. Both colonies took an additional 10 g on the next day. By 10 May the gardens had increased to 2,600 ml (Colony B), 700 ml (Colony C) and 3,500 ml (Colony D), having taken in the preceding month 250 g, 103 g and 220 g of substrate, respectively. Colony D was clearly less active than Colony B since it had a garden of 3,500 ml already in March. By the end of July the gardens had changed markedly, that of Colony B being 1,800 ml on June substrate of 373 g, C was 1,250 ml on 200 g of substrate and D was 1,700 ml on 360 g. Such fluctuations were not uncommon during periods of my absences and with substitute care.

In a comparison of rate of cutting grapefruit pith among six attine species in early 1969 the workers of these colonies did well: Colony B cut and transported 20 g in 6 h 40 min, Colony C cut and transported 20 g in 6 h 30 min, and Colony D cut and transported 20 g in 4 h 30 min.

Table 1. Monthly use of fresh substrate and growth of the gardens in Colony C¹.

	Substrate use in grams		Total for year	Garden size estimated in milliliters	
	minimum	maximum		minimum	maximum
1966	20	145	500	12	480
1967	46	325	2,214	150	3,900
1968	190	530	4,722	1,950	6,100
1969	250	488	3,929	3,900	5,300
1970	160	300	2,689	2,500	5,000
1971	30	175	1,496	800	3,100
1972	87	410	1,001	1,800	2,700
1973	56	460	2,137	500	2,900
1974	45	130 ²	720 ²	300	2,500
1975				650	1,700 ²

¹ No measurements made in 1965.² To 1 July.

Corresponding volumes of garden were 4,500, 5,400 and 3,700 ml. respectively.

The 1969 and 1970 monthly records of substrate taken and garden size are graphed in Weber, 1972b for Colony B.

The Ants

The worker ants range in length from the minima (1.5–3 mm), to the media (4–6 mm) and the maxima (7–8 mm), measuring to the nearest whole mm except the smallest. Sample live weights in Colony B in 1967 were 0.65, 0.85, 2.89, 5.00, 8.85, 12.62 and 15.50 mg. Three alate females weighed 36.44, 43.9 and 46.2 mg, respectively, and an egg-laying female in a sister colony weighed 26.65 mg. The female length was 10 mm and the thorax 4.0 mm. The castes are figured in Weber, 1972a.

Populations of the colonies estimated on 16 January 1968 were 10,000 workers (Colony B), 8,000–15,000 (C) and 10,000 (D). These estimations were based on the actual population of the colony that I took in 1935 that was the subject of the book by W. M. Wheeler (1937). This 1935 colony had a garden of a size comparable to that of C. It had a worker count of 7,166. Another population estimate may be based on that of actual counts of workers of *Atta cephalotes* and *sexdens* in gardens of 1,700–1,800 ml. These were in the 8,000–9,000 ant range.

Colonies B and D came to an end in March 1973 and July 1974, respectively. B was lost through desiccation during my absence. Colony D

was believed to be ending on 9 October 1970 when it had a garden of 80 ml. It gradually revived and was used in 1971 for class demonstrations when it had a garden of 300 ml and an estimated 500–600 workers. The garden was also 300 ml on 17 March 1973. The mechanical shock to the garden in moving the colony to Cambridge, Massachusetts for a few weeks and the temperature changes caused its death the following year.

This species has a marked "bloom" at times, a waxy cuticular excretion probably, and this was especially prominent on the workers of Colony B on 9 September 1968. The minima lick and sponge leaf sections as in *Atta*. The workers may carry water to the garden as in *Atta*.

Sexual Broods

Sexual broods in nature may occur in the second colony year according to the limited observations in Weber (1945) where I noted a colony in Trinidad on 28 May 1936 with winged females that was not seen at the same site (the top of a tree stump) on 19 March 1935. The colony may have been so small in the earlier year that it was overlooked, since attention was then concentrated on other ants at this site.

No sexual brood was present in Colonies B, C, and D in 1966 and their occurrence in later years was as follows:

1967.—Two callow alate females were discovered in Colony D on 20 March. They had probably left the pupal stage on the 15th to 17th. Also present were media worker callows showing that both worker and female broods were simultaneously produced. The estimated garden size was 2,200 ml in Colony B, only 250 ml in C and 3,500 ml in D. Thus maturation of a sexual brood seemed to depend in part on garden size. Eight alate females were present in Colony D by 31 March. On 15 May one dealate and one alate female were wandering in the feeding chamber and on the 16th there were 13 in an empty chamber clustered with workers. Ten were removed with an experimental nest with workers, and a piece of the garden, where seven lived until late summer, feeding themselves; the workers were more effective in culturing the garden.

Several of these with a few workers had on 13 August two plump larvae, almost semipupae, and on the 15th a third was present. In addition there were 3–5 eggs in each of two places that probably came from the virgin females but the origin of the larvae was less certain. In the meanwhile by 31 May, 80 alate females were counted in the parental nest.

On 11 August the alate females were still clustering as they had for months in an originally empty chamber. This chamber was between two with good gardens and it was clear that the ants had substantially left their original rearing site. This is also the situation in *Atta* in nature.

On 28 September about 20–25 alates were still standing quietly in one

corner of the same chamber they occupied in May. One of these on 30 October weighed 36.44 mg with all wings. Four isolated survivors on 21 October had one egg and other eggs had probably been laid by them on other occasions but had not been reared. On the 28th there were still alates in the May empty chamber. The gardens on 18 December had grown as follows: Colony B had 5,600 ml; Colony C had 3,600 ml and Colony D had 5,100 ml. On the 26th an active alate was in the feeding chamber in Colony D. Therefore, 1967 ended with only Colony D producing a sexual brood although Colony B had a larger garden.

1968.—There was a new female brood in Colony D on 25 February and Colony C had its first maturing female on 15 April. The latter colony on 3 June was at the same time maturing a worker brood including the maxima while it had the females.

The 1967 brood of Colony D was dying in early 1968 when a new brood was maturing in February. There were new mature females and some pupae on 25 February. However, by the next day there were discarded and dying female pupae as well as adults. Similar deaths occurred through March and into late April. On 15 April an alate female ran out into the feeding chamber. Colony B had no visible females at this time. A Colony D dealate female was cutting pith for that garden on the 17th. A female of this brood that had lost a wing was active here on the 24th, at the same time that the females of Colony C were now wandering about, signifying their maturity. Two dealate females of the colony are shown in Fig. 142, Weber, 1972a.

Colony D on 7 May had a large brood of females clustering together. At the same time a few females of Colony C were wandering about and there were none to be seen in Colony B. Gardens of the latter were deteriorating badly on the 13th, perhaps from an excess of moisture from azalea leaves. Colony D cast out some worker pupae on the 20th and on the 28th 10 dead females appeared to be unusually small, a sign of abnormal conditions in the garden, probably from overuse of succulent flowers. The alates of Colonies C and D on 4 June were feeding on the staphylae (clusters of inflations) on the ant fungus; callow workers were manipulating the sections of rose petals brought to the garden while the alate females did no work. Many alates were present on the gardens in Colonies C and D on 16 August, some having lost their wings. On 9 November alate females of Colony C were on the garden and one that had lost its wings was cutting a rhododendron leaf and carrying it to the garden, as were two dealate females in Colony D at the same time. The females also worked over the exhausted substrate as do workers, apparently inactivating contaminants or ingesting something. Females remained in both colonies through the end of 1968.

1969.—Colony C had a female brood of larvae and pupae on 7 Feb-

ruary and on the 14th all three colonies had female broods, the first time for Colony B. These matured and some remained alive in each colony for the remainder of the year. By late August several were dying daily without wings. A fourth colony of the species (No. 4350) from Trinidad but taken in 1964 also had a female brood at the end of the year. The size of the gardens of the four on 15 December were 4,600 mg (Colony B), 4,800 mg (Colony C), 3,000 mg (Colony D) and 4,500 mg (Colony 4350).

1970.—The three colonies retained their female broods into June, many becoming dealate, and few were left by September.

1971.—By 5 January Colony B had the most, there were a few in Colony C and several in Colony D. By 20 February alate females were dying in numbers in the colonies and three remained in Colony D on 29 March. One dealate was seen on 18 July in Colony C and Colony B was developing a female brood. A few were adult in the latter on 26 July but none was seen in the other two colonies that had much smaller gardens. On 24 August several of the Colony B alate females were agitated, taking short, erratic runs but were not seen to fly. They were quiet on 27 September. Colony D on 11 November was used for study by students and then had worker callows of all sizes and one dead female. By the end of the year only Colony B had alate females.

1972.—Colony D was transferred to a new chamber on 6 January and in the process the garden was broken into several pieces. By the 11th the rebuilding of the garden was well underway and the original queen was seen on occasion. There seemed to be several dealate females that had been hidden before. Colony C started a new garden on the 16th. Colony B had alate females on 8 March.

Colony D was used for experiments with fungus cultures of other attines (see Weber, 1972a, 1972b, 1972c) in May. For example, the workers ate the fungus of *Acromyrmex* (*Moellerius*) *landolti* Forel. Colony B had alate females on 10 September. On 1 December a small part of the garden of Colony C was given to a colony of *Acromyrmex lobicornis* Emery from Argentina and was accepted by them. (Given more on 7 July 1973.) Three live dealate females were seen 15 December in Colony B and there were probably more present.

1973.—No alate females were seen in Colonies C and D on 7 January and there were many in Colony B of which 10 were dealates engaged at one time in cutting and carrying pith to their garden. Colony B was deteriorating badly on 8 March and on the 19th the queen, eight years old, was dead. She was immaculate and entire. Her last female brood consisted of abnormally small individuals. These, when dead, were carried to a refuse pile and left. The queen had normal workers and the colony died accidentally from lack of care during my absence. Colony D was re-

duced in size 13 April. Parts of the garden of Colony D were given to new South American colonies of attines, including the Argentine *Acromyrmex* (*Acromyrmex*) *lobicornis* Emery and *A.* (*Moellerius*) *heyeri* Forel on 26–27 August and were tended by these ants for a few weeks.

1974.—Colony D was fairly stable on 18 February and on 2 April had one good garden and a small new one. Colony C was similar. On 25 June the estimated volume of Colony C garden was 1,400 ml and of Colony D 1,500 ml. The entire attine collection was moved out of the laboratory and taken to Harvard University, Cambridge, Massachusetts on 2 July. The queen of Colony D died here and was preserved on 16 July, death of the colony being caused by mechanical shock and temperature changes. Colony C survived a second move, to Florida State University, Tallahassee, Florida in August and lived for more than a year but without producing a sexual brood.

Addendum

Colony C survived nearly another year, the last workers dying in June 1976. The volume of the garden in ml fluctuated from 1,100 (1 August) to a high of 2,000 (1 October) and was 1,500 on 15 December 1975. Sporadic temperatures as much as 5°–6°C lower than optimum caused the garden to deteriorate in the winter to 850 ml on 28 March 1976. It was dead by 13 April and was discarded piece by piece by the ants, the queen also dying. Workers were kept alive briefly by giving them pieces of the gardens of *Atta cephalotes* and *colombica tonsipes* but mostly they fed on pulp of orange and grapefruit in April and May. An examination of the accumulated dead ants of 1976 revealed no sexual forms. The last survivors probably resulted from an early 1975 brood of eggs.

Other Trinidad Colonies of this Species

During this 10-year period, other Trinidad colonies of *Acromyrmex octospinosus* taken within 100 m of B, C and D and were kept in the same laboratory. The colony numbers are given here since they correspond with collection numbers of all specimens (including those of Colonies B, C and D, respectively No. 4421.1, 4421.2 and 4421.3) now deposited in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts 02138, where my ant collection is.

One, No. 4350, was taken 14 July 1964 in an experimental cacao plot of the University of the West Indies by Peter Weber. It had a garden of several thousand ml that was heavily rained on in the collecting, damaging much of the garden. The colony was fully one year old and for years was more vigorous than B, C or D. This queen was 11 years old when she and the colony died as a result of moving it from Swarthmore to Harvard.

The garden attained a maximum size of 6,900 ml in December 1968, a year in which 5.073 g of substrate was used, and produced several female broods.

A colony (No. 4441) taken 15 July 1965 in the Trinidad *Dracaena* hedge of the map (lower left corner, Ac) in Weber, 1972a (Figs. 112–113) was of unknown age. It produced male and female broods by 13 April 1966.

Females (Nos. 4509–4521) from a 0730 h nuptial flight 9 June 1967 similar to that of 1 July 1965 were taken to the laboratory and isolated as before. One (No. 4518) retained the wings on her left side and, like others, started producing a brood. By 18 September she had produced a brood of callow minima and small media workers.

Three recently fertilized queens (Nos. 4706–4708) were given to me on 11 July 1970 by D. J. Stradling, who took them in the same area of Colonies B, C and D. I gave them small portions of the garden of No. 4350 and on the 11th, since they lost their original nucleus, kept them separately under observation for a record of brood development at 25–37°C as follows:

Egg stage 24 days maximum (first eggs 16 July; probably some were eaten), larval stage 18 days maximum (first larva 12 August), semipupa stage 5 days maximum (first semipupa 7 September), pupa stage 16 days maximum (first pupa 12 September), and callow workers first appeared 28 September.

It is unlikely that the first eggs were the ones to mature as callow workers and the egg to adult period is probably about two months.

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NOTES ON THE BITING MIDGES OF THE SEYCHELLES
(DIPTERA: CERATOPOGONIDAE)¹

Willis W. Wirth and Donald H. Messersmith

Abstract.—Seventeen species of Ceratopogonidae collected in the Seychelles Islands are reported, including two new species and two species not previously recorded from the islands. The correct generic placements and some synonymies are listed for the 22 species and five varieties described from the Seychelles by Kieffer in 1911. *Dasyhelea bipunctata* n. sp. and *D. tamsi* n. sp. are described. The list of known Seychelles species now totals 26. The following new synonymy is made: *Bezzia ornatissima* (Kieffer) (syn.: var. *bipunctata* (Kieffer)); *Bezzia rufipes* (Kieffer) (syn.: var. *femoralis* (Kieffer)); *Culicoides leucostictus* Kieffer (syn.: *praetermissus* Carter, Ingram and Macfie, and *distinctipennis* var. *egypti* Macfie); *Dasyhelea aurantiaca* (Kieffer) (syn.: var. *mahensis* (Kieffer)); *Forcipomyia borbonica* Clastrier (syn.: *penniornata* Tokunaga and Murachi, *fuscimaculata* Hardy, *stabilis* Sen and Das Gupta, and *petersoni* (Chan and LeRoux); *Forcipomyia chrysolopha* (Kieffer) (syn.: *ornatipes* (Kieffer), *variegata* Goetghebuer, and *lepidota* Ingram and Macfie); *Forcipomyia psilonota* (Kieffer) (syn.: *aplonota* (Kieffer), *seychelleana* (Kieffer), *seychelleana* var. *fulvithorax* (Kieffer), *indecora* Kieffer, *ingrami* Carter, *egypti* Macfie, *congolensis* Goetghebuer, *flavopilosella* Goetghebuer, *griseipluma* Goetghebuer, *lulengaensis* Goetghebuer, *superata* Goetghebuer, and *griseolella* Goetghebuer); *Nilobezzia scotti* (Kieffer) (syn.: *Probezzia longipennis* (Kieffer)).

We are taking this opportunity to report on two recent collections of Ceratopogonidae made in the Seychelles Islands in the Indian Ocean. Through the courtesy of A. M. Hutson, Richard Lane, and the Trustees of the British Museum (Natural History) we have been able to examine a collection made by W. T. Tams and I. W. Nye in 1965. The junior author made a trip to the Seychelles in May 1972 (with the assistance of British Airways) and collected additional material. We are as a result now able to present an up-to-date list and synonymies of the known Ceratopogonidae of the Seychelles and to present two records from Mauritius.

Kieffer (1911) described 22 species and five varieties of Ceratopogonidae from the material collected in the Seychelles during the Percy Sladen Trust Expedition in 1905. Since that time there have been no records of Ceratopogonidae from the Seychelles until Lambrecht (1970) reported two blood-sucking species, *Leptoconops* (*Styloconops*) *spinosifrons* (Carter) and *Culicoides kusaiensis* Tokunaga. Kieffer's types are in the British Museum

(Natural History) in London where they were examined by the senior author in 1973. We are greatly indebted to Richard Lane and the Trustees of the Museum for allowing us to make further studies and lectotype designations of certain species which are reported here. The correct generic assignments, etc., of Kieffer's species are as follows:

Kieffer, 1911:	Present Assignment:
<i>Ceratopogon:</i>	
<i>trichotomma</i> , p. 332	<i>Atrichopogon</i> , NEW COMBINATION
<i>chrysolophus</i> , p. 333	<i>Forcipomyia</i> , subgenus <i>Lepidohelea</i>
<i>lasionotus</i> , p. 334	synonym of <i>Forcipomyia</i> (<i>Microhelea</i>) <i>fuliginosa</i> (Meigen)
var. <i>callithorax</i> , p. 334	synonym of <i>Forcipomyia</i> (<i>Microhelea</i>) <i>fuliginosa</i> (Meigen)
<i>lampronotus</i> , p. 335	<i>Atrichopogon</i> , NEW COMBINATION
<i>psilonotus</i> , p. 337	<i>Forcipomyia</i> , subgenus <i>Euprojoannisia</i>
<i>aplonotus</i> , p. 337	synonym of <i>Forcipomyia</i> <i>psilonota</i> , NEW SYNONYMY
<i>seychelleanus</i> , p. 338	synonym of <i>Forcipomyia</i> <i>psilonota</i> , NEW SYNONYMY
var. <i>fulvithorax</i> , p. 338	synonym of <i>Forcipomyia</i> <i>psilonota</i> , NEW SYNONYMY
<i>falcinellus</i> , p. 338	<i>Forcipomyia</i> (<i>Thyridomyia</i>)
<i>mahensis</i> , p. 339	<i>Forcipomyia</i> (<i>Lasiohelea</i>)
<i>Culicoides:</i>	
<i>leucostictus</i> , p. 340	<i>Culicoides</i> (<i>Meijerehelea</i>)
<i>seychellensis</i> , p. 341	<i>Dasyhelea</i> , NEW COMBINATION
<i>scotti</i> , p. 341	<i>Dasyhelea</i> , NEW COMBINATION
<i>aurantiacus</i> , p. 342	<i>Dasyhelea</i> , NEW COMBINATION
var. <i>mahensis</i> , p. 342	synonym of <i>Dasyhelea</i> <i>aurantiaca</i> , NEW SYNONYMY
<i>Sphaeromyias:</i>	
<i>hexacantha</i> , p. 343	<i>Hebetula</i>
<i>pulchripennis</i> , p. 344	<i>Monohalea</i>
<i>areolaris</i> , p. 345	<i>Stilobezzia</i>
<i>Serromyia:</i>	
<i>festiva</i> , p. 346	<i>Serromyia</i>
<i>Pachyleptus:</i>	
<i>rufipes</i> , p. 347	<i>Bezzia</i>
var. <i>femoralis</i> , p. 347	synonym of <i>Bezzia</i> <i>rufipes</i> , NEW SYNONYMY
<i>Probezzia:</i>	
<i>scotti</i> , p. 348	<i>Nilobezzia</i>
<i>longipennis</i> , p. 349	synonymy of <i>Nilobezzia</i> <i>scotti</i> , NEW SYNONYMY
<i>ornatissima</i> , p. 349	<i>Bezzia</i>
var. <i>bipunctata</i> , p. 350	synonymy of <i>Bezzia</i> <i>ornatissima</i> , NEW SYNONYMY
<i>seychelleana</i> , p. 350	<i>Bezzia</i>

Forcipomyia (*Euprojoannisia*) *psilonota* (Kieffer)

Ceratopogon psilonotus Kieffer, 1911:337 (♂; Seychelles; fig. wing).

Forcipomyia psilonota (Kieffer); Ingram and Macfie, 1924:546 (combination; in key).

- Ceratopogon aplonotus* Kieffer, 1911:337 (♀; Seychelles; fig. wing). NEW SYNONYMY.
- Forcipomyia aplonota* (Kieffer); Ingram and Macfie, 1924:543 (combination; in key).
- Ceratopogon seychelleanus* Kieffer, 1911:338 (♀; Seychelles; fig. wing). NEW SYNONYMY.
- Forcipomyia seychelleana* (Kieffer); Ingram and Macfie, 1924:543 (combination; in key).
- Ceratopogon seychelleanus* var. *fulvithorax* Kieffer, 1911:338 (♀; Seychelles). NEW SYNONYMY.
- Forcipomyia seychelleana* var. *fulvithorax* (Kieffer); Ingram and Macfie, 1924:543 (combination; in key).
- Forcipomyia indecora* Kieffer, 1914:269 (♂; South Africa); de Meillon, 1959:327 (redescribed from types; synonym: *ingrami* Carter); Clastrier, 1960:510 (♂ redescribed; fig. genitalia); Dessart, 1961:335 (descriptive notes; synonyms: *ingrami*, *egypti*, *congoensis*, *flavopilosella*, *griseipluma lulengaensis*, *superata*, *griseolella*). NEW SYNONYMY.
- Forcipomyia ingrami* Carter, 1919:290 (all stages; Gold Coast; figs.); Ingram and Macfie, 1924:584 (notes; figs.). NEW SYNONYMY.
- Forcipomyia egypti* Macfie, 1924:61 (♀; Egypt; figs.). NEW SYNONYMY.
- Forcipomyia congolensis* Goetghebuer, 1933:132 (also as *congoensis*, p. 130; ♂; Congo; figs.). NEW SYNONYMY.
- Forcipomyia flavopilosella* Goetghebuer, 1933:135 (also as *flavopilosella*, p. 130; ♀; Congo; fig. wing). NEW SYNONYMY.
- Forcipomyia griseipluma* Goetghebuer, 1935:154 (♂; Congo). NEW SYNONYMY.
- Forcipomyia lulengaensis* Goetghebuer, 1935:155 (♂; Congo; fig. wing). NEW SYNONYMY.
- Forcipomyia superata* Goetghebuer, 1935:160 (♀; Congo; fig. wing). NEW SYNONYMY.
- Forcipomyia griseolella* Goetghebuer, 1948:7 (♀; Congo). NEW SYNONYMY.

Distribution.—SEYCHELLES: Mahé, Anse aux Pins, 24 May 1972. D. H. Messersmith, at light, 1♀. Mahé, Beau Vallon, 27 April, 25 May 1965. Tams and Nye, 2♀♀. Mahé, Cascade, 10 March, 1965. Tams and Nye, 1♀.

Remarks.—Through the courtesy of Mr. Richard Lane and the Trustees of the British Museum (Natural History) we have been able to study the type-series of Kieffer's species *pilonota*, *aplonota*, and *seychelleana*. As LECTOTYPE of *pilonota* we have chosen a male, mounted on a slide. This specimen has the hind tarsal ratio 0.71, well within the range of 0.67–0.93 given by Dessart (1963) in his redescription of *indecora*. The female tarsal ratio of this species varies from 1.1 to 1.3. The genitalia of the lecto-

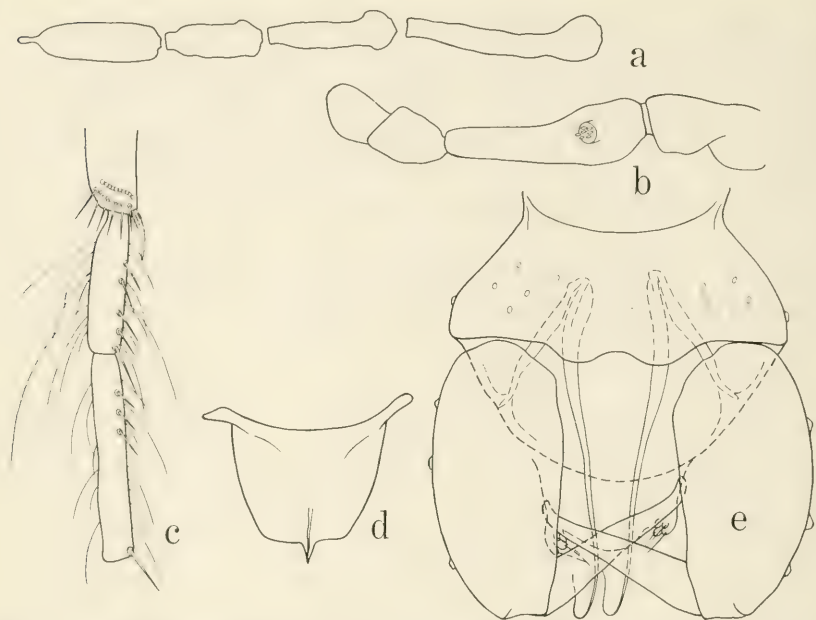


Fig. 1. *Forcipomyia biannulata*, male. a, 4 distal antennal segments. b, palpus. c, tibial comb and proximal 2 tarsomeres of hind leg. d, aedeagus. e, genitalia, aedeagus removed (drawn by M. Griffin).

type are identical with those figured by Carter (1919), Ingram and Macfie (1924), and Clastrier (1960) for *ingrami* and *indecora*. We have no hesitation in completing the synonymy given above for this common and widespread Ethiopian species.

Forcipomyia (Forcipomyia) biannulata Ingram and Macfie
(Fig. 1)

Forcipomyia biannulata Ingram and Macfie, 1924:557 (♂, ♀; Gold Coast, Nigeria, Nyasaland; figs.); Clastrier, 1960:515 (descriptive notes; Congo); Dessart, 1961:357 (redescribed; extensive synonymy).

Forcipomyia abonnenci Clastrier, 1959a:340 (♂, ♀; Senegal; figs.).

Distribution.—Common and widespread in Ethiopian Region. SEYCHELLES: Mahé, Reef Hotel Golf Course, 22 May 1972, D. H. Messersmith, black light, 1♂; 20 May 1972, on person, 1♂. Mahé, Beau Vallon, 30 March, 25 April, 27 May 1965, Tams and Nye, 3♂♂, 24♀♀. MAURITIUS: Roches Noires, 24 May 1969, C. M. C., 4♀♀ (BMNH).

Diagnostic Characters.—This species has been well characterized by Ingram and Macfie (1924), Clastrier (1959a, as *abonnenci*), and Dessart (1961). A moderately small species, wing 1.3 mm long; wing dark with

small yellowish spot over end of costa; legs pale, femora with broad distal, and tibiae with broad basal dark bands; mid and hind tibiae of ♀ with hastate spines; hind TR 0.66 (Fig. 1c). Male aedeagus (Fig. 1d) broader than long, shield-shaped with median point; parameres (Fig. 1e) broadly separated at base, no sclerotized basal bridge, distal processes free to base, moderately slender, tapering to a filament.

Forcipomyia (Lasiohelea) mahensis (Kieffer)

Ceratopogon mahensis Kieffer, 1911:339 (♀; Seychelles; fig. tarsus).

Forcipomyia mahensis (Kieffer); Dessart, 1963:88 (combination).

Distribution.—Seychelles Islands. SEYCHELLES: Mahé, Beau Vallon, 8 April 1965, Tams and Nye, 1♀.

Forcipomyia (Lepidohelea) chrysolopha (Kieffer)
(Fig. 2)

Ceratopogon chrysolophus Kieffer, 1911:333 (♂, ♀; Seychelles; fig. wing).
Lepidohelea chrysolopha (Kieffer); Kieffer, 1917:364 (type-species of *Lepidohelea*, new genus).

Forcipomyia chrysolopha (Kieffer); Ingram and Macfie, 1924:542 (combination; in key).

Lepidohelea ornatipes Kieffer, 1921:1 (♂, ♀; Cameroon; fig. ♂ genitalia).
NEW SYNONYMY.

Forcipomyia lepidota Ingram and Macfie, 1924:566 (♂, ♀; Gold Coast; figs.); Macfie, 1934:178 (rec. Malaya); Macfie, 1937:73 (rec. Ethiopia); Macfie, 1947:70 (rec. Sudan); de Meillon and Hardy, 1953:29 (Cape Prov.); Clastrier, 1956:606 (redescribed; figs.; Tunisia, Algeria); Clastrier, 1960:513 (Congo); Dessart, 1961:362 (redescribed; figs.; synonyms: *annulator*, *grata*, *guttatella*, *variegata*); Dessart, 1963:82 (redescribed; figs.; synonymy); Clastrier, 1966:694 (Canary Is.). NEW SYNONYMY.

Forcipomyia variegata Goetghebuer, 1933:133 (♀; Congo; fig. wing, leg).
NEW SYNONYMY.

Forcipomyia guttatella Goetghebuer, 1935:146 (♀; Congo; fig. wing; also spelled *guttatula*). NEW SYNONYMY.

Forcipomyia grata Goetghebuer, 1935:153 (♂; Congo; fig. wing). NEW SYNONYMY.

Forcipomyia annulator Goetghebuer, 1948:6 (new name for *grata* Goetghebuer 1935, preocc. Macfie, 1934). NEW SYNONYMY.

Distribution.—Widespread in Ethiopian and Oriental Regions. SEYCHELLES: Mahé, Anse aux Pins, 24 May 1972. D. H. Messersmith, at light, 2♂♂. MAURITIUS: Roches Noires, 19 June 1969. C. M. C., 1♀ (BMNH).

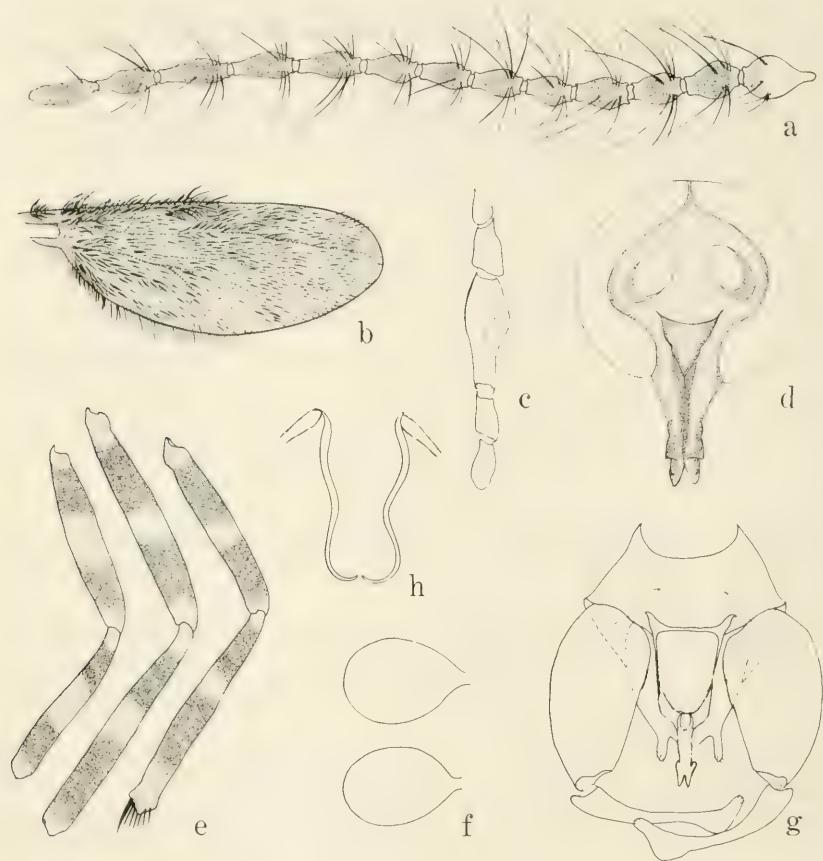


Fig. 2. *Forcipomyia chrysolopha*, a-f, female, g-h, male. a, antenna. b, wing. c, palpus. d, anterior view of head. e, color pattern of femora and tibiae (left to right) of fore, mid, and hind legs. f, spermathecae. g, genitalia. h, parameres (drawn by N. C. Ratanaworabhan).

Diagnostic Characters.—A dark brown species with banded legs (Fig. 2e), readily distinguished from *F. borbonica* by the presence of a median yellowish band on the hind femur, the abundant appressed scales of the body and legs much shorter and broader, and by the more slender third palpal segment (Fig. 2c) with a shallower sensory pit. Hind tarsal ratio of ♀ 0.90, of ♂ 0.82. Male genitalia (Fig. 2g) with dististyle swollen distally with very characteristic, obliquely capitate expansion; aedeagus also with specifically characteristic distal expansion, the basal arch very low, nearly transverse; parameres (Fig. 2h) separate, the long posterior processes tapering to slender, slightly sinuate rods. This species has been very well re-

described and figured by Clastrier (1956) and Dessart (1961) under the synonym *F. lepidota* Ingram and Macfie. This common and widespread species is the type-species of the subgenus *Lepidohelea* Kieffer.

Forcipomyia (Microhelea) fuliginosa (Meigen)

Ceratopogon fuliginosus Meigen, 1818:86 (Europe).

Forcipomyia fuliginosa (Meigen); Goetghebuer, 1933:130 (combination; Congo); Dessart, 1962:67 (synonyms: *lasionotus*, *callithorax*).

Ceratopogon lasionotus Kieffer, 1911:334 (♂, ♀; Seychelles).

Ceratopogon lasionotus var. *callithorax* Kieffer, 1911:335 (♂, ♀; Seychelles).

Distribution.—Cosmopolitan. SEYCHELLES: No locality, February–March 1965, Tams and Nye, 7♂♂, 1♀.

Forcipomyia (Schizoforcipomyia) borbonica Clastrier
(Fig. 3)

Forcipomyia (Lepidohelea) borbonica Clastrier, 1959b:436 (♂; Réunion Id.; fig. genitalia; publ. Sept. 1959).

Forcipomyia (Forcipomyia) penniornata Tokunaga and Murachi, 1959:163 (♂, ♀; Bonin Is., S. Mariana Is., Caroline Is.; figs.; publ. 6 Nov. 1959). NEW SYNONYMY.

Forcipomyia (Metaforcipomyia) fuscimaculata Hardy, 1960:170 (♂, ♀; Hawaii; figs.). NEW SYNONYMY.

Forcipomyia (Forcipomyia) stabilis Sen and Das Gupta, 1968:95 (♂, ♀; India, West Bengal; figs.). NEW SYNONYMY.

Forcipomyia (Schizoforcipomyia) petersoni Chan and LeRoux, 1971:271 (all stages; Singapore; figs.). NEW SYNONYMY.

Distribution.—Widespread in Old World Tropics. SEYCHELLES: Mahé, Anse aux Pins, 24 May 1972, D. H. Messersmith, at light 3♂♂, 1♀. Mahé, Beau Vallon, 27 April, 25 May 1965, Tams and Nye, 2♀♀.

Diagnostic Characters.—Wing length, ♀ 0.83–0.93 mm; ♂ 1.05–1.40 mm. A dark brown species with broad pale leg bands (Fig. 3f), hind femur entirely dark; wing with indistinct pattern of 4 darker areas on anterior margin caused by clumps of longer scalelike hairs. Female antenna as in Fig. 3a. Palpus (Fig. 3b) 5-segmented, 3rd segment with deep sensory pit opening by a smaller, round pore. Hind tibial comb as in Fig. 3e. Hind tarsal ratio 0.92–0.96 in ♀ (Fig. 3g), 0.68–0.84 in ♂. Two ovoid spermathecae (Fig. 3c) with short, moderately sclerotized necks. Female genital sclerotization as in Fig. 3d. Male genitalia (Fig. 3h) with 9th segment relatively long, sternum with a denser row of hairs in middle of posterior margin; aedeagus in form of a V with a pair of slender, pointed, ventrolaterally directed processes arising from the caudal apex of the V; parameres with

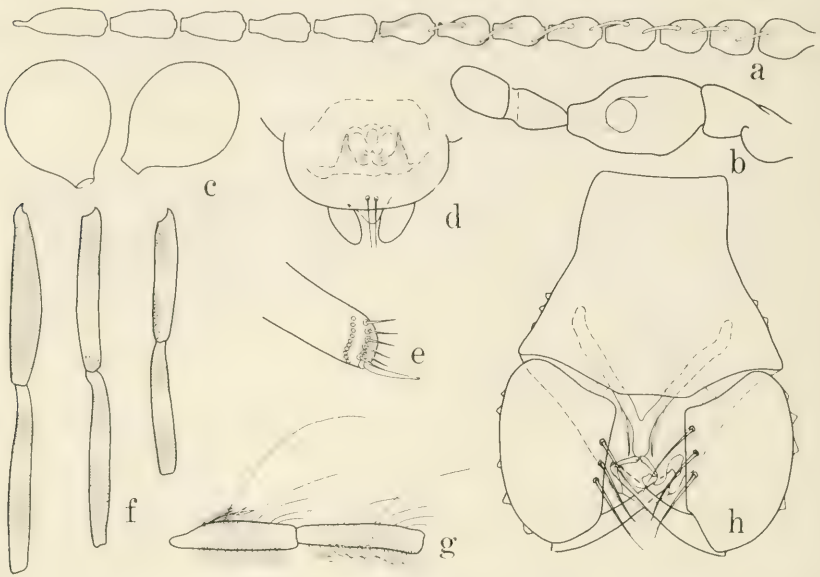


Fig. 3. *Forcipomyia borbonica*, a-f, female, g-h, male. a, antenna. b, palpus. c, spermathecae. d, genital sclerotization. e, hind tibial comb. f, color pattern of femora and tibiae of (left to right) hind, mid, and fore legs. g, proximal 2 tarsomeres of hind legs. h, genitalia (drawn by M. Griffin).

basal apodemes forming a broad, U-shaped arch and bearing a pair of tapering, slender-pointed caudal processes with tips reaching tip of aedeagus; basistyles each with 2-3 long bristle-like hairs on mesal face; dististyle slender, nearly straight with pointed tip. Larva nearly as in *Forcipomyia s. str.*; head hypognathous, *p* and *q* hairs long and slender; anterior and posterior pseudopods bilobed, each lobe with crown of short dark hooks; body chaetae numerous, rather long, *a* hairs spear-shaped but not so rounded as in *Forcipomyia s. str.*; *b* hairs long, thickened basally. Pupa similar to that of *Forcipomyia s. str.*; spiny with many moderately long tubercles, most bearing a short seta at apex; larval exuviae retained on posterior segments; prothoracic respiratory horn short and thumb-shaped, with about 11 spiracular papillae curving around apex and down posterior margin; male sexual processes dorsal.

Discussion.—The new synonymy is based on the excellent and diagnostic figures published by the authors of all the species mentioned, as well as by examination of type or paratype material of *penniornata*, *fuscimaculata*, and *petersoni*. We have also identified a good series of adults of this species from Thailand (Bangkok, Scanlon coll.), Sarawak (Lutong, Colless

coll.), North Borneo (Tambunan, Colless coll.), and Samoa (Tutuila, Pago Pago, Kellen coll.).

Atrichopogon lampronotus (Kieffer), new combination

Ceratopogon lampronotus Kieffer, 1911:335 (♂, ♀; Seychelles; fig. ♀ wing, ♂ genitalia).

Distribution.—Seychelles Islands. SEYCHELLES: Mahé, Anse aux Pins, 24 May 1972, D. H. Messersmith, at light, 2♀♀.

Atrichopogon trichotomma (Kieffer), new combination

Ceratopogon trichotomma Kieffer, 1911:332 (♂, ♀; Seychelles; fig. wings ♂, ♀).

Distribution.—Seychelles Islands. SEYCHELLES: Mahé, Beau Vallon, 27 April, 25 May 1965, Tams and Nye 8♂♂, 19♀♀. Mahé, Mission site, 25 May 1972, D. H. Messersmith, 1♀.

Remarks.—This species is distinguished from *A. lampronotus*, the only other described Seychelles' *Atrichopogon*, by its smaller size (wing 1.5 mm long), shining brownish-black color with yellowish legs, and absence of macrotrichia on the wing membrane.

Genus *Dasyhelea* Kieffer

Kieffer described three species and one variety of *Dasyhelea* from the Seychelles under the genus *Culicoides*. Through the kindness of A. M. Hutson and Richard Lane and the trustees of the British Museum (Natural History) we have been able to study syntypes of Kieffer's species in order better to characterize the species and to select lectotypes.

Dasyhelea seychellensis (Kieffer), new combination
(Fig. 4i, 4j, 4k)

Culicoides seychellensis Kieffer, 1911:341 (♂, ♀; Seychelles).

Types.—Described from two syntypes from Mahé, Seychelles: 1♀, Cascade Estate, about 1,000 feet and over; 1♂, Cascade Estate, about 800–1,500 feet, 1909. We have dissected the genitalia from the ♂ which we hereby designate as LECTOTYPE.

Distribution.—Seychelles Islands. SEYCHELLES: Mahé, Beau Vallon, 12–30 April 1965, Tams and Nye, 4♀♀.

Female.—Wing length 1.07 mm. Costal ratio 0.56. A moderately large dark brown species with bluish-green pollinose thorax; scutellum yellowish. Legs yellowish brown with blackish knee spots and faint, broad, median

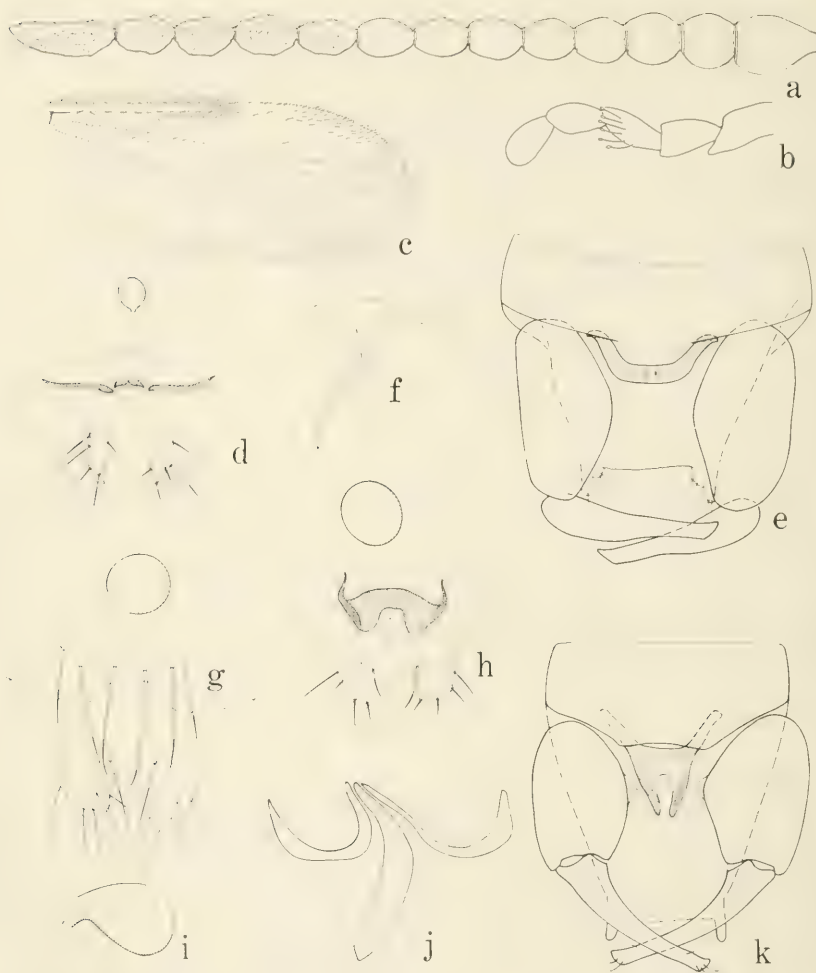


Fig. 4. *Dasyhelea* spp. a-d, *D. tamsi*, female. a, antenna. b, palpus. c, wing. d, genital sclerotization and spermatheca. e-g, *D. bipunctata*. e, male genitalia, parameres removed. f, male parameres. g, female genital sclerotization and spermatheca. h, *D. scotti*, female genital sclerotization and spermatheca. i-k, *D. seychellensis*. i, female spermatheca. j, male parameres. k, male genitalia, parameres removed (drawn by B. Ackerberg).

brownish bands on femora and tibiae. Halter infuscated. Spermatheca (Fig. 4i) retort-shaped with stout, oblique neck; measuring 0.080 by 0.058 mm.

Male Genitalia (Fig. 4k).—Ninth sternum weakly bilobed at base of aedeagus; 9th tergum short and broad, tapering to moderately long,

digitiform, apicolateral processes which are moderately separated with caudal margin weakly convex between them. Basistyle short and stout, mesal process inconspicuous; dististyle unusually long and slender, slightly curved and tapered to slender, slightly hooked tip. Aedeagus of usual form with low basal arch and a submedian pair of moderately long and slender caudal processes. Parameres (Fig. 4j) asymmetrical, basal apodemes long and slender, curved; median caudal process sinuate, slender at base and broadened in midportion, stout distally.

Note.—This species belongs in the large and difficult *fusca* group. Structurally it is very similar to *D. tugelae* de Meillon from South Africa, but *tugelae* is a larger species (wing length 1.4 mm) and the legs are not banded.

Dasyhelea aurantiaca (Kieffer), new combination

Culicoides aurantiacus Kieffer, 1911:342 (♂, ♀; Seychelles).

Culicoides aurantiacus var. *mahensis* Kieffer, 1911:342 (♀; Seychelles).

NEW SYNONYMY.

Distribution.—Seychelles Islands.

Types.—Described from 1♂, 3♀♀ from Mahé, Seychelles, Cascade Estate, about 800–1,500 feet, 1909. Var. *mahensis* described from 2♀♀, same data. We have seen 2 pinned ♀♀ of *aurantiacus* from which we have selected the ♀ bearing the handwritten label "*Culicoides aurantiacus*" as LECTOTYPE. We have seen one pinned ♀ of var. *mahensis* bearing the handwritten label "*Culicoides aurantiacus* var." which we have labeled as LECTOTYPE.

Note.—This species is a tiny polished reddish-yellow species with blackish abdominal terga. In the lectotype of *aurantiacus* the abdomen was distended when glued to the card on the pin giving the segmented appearance described by Kieffer, while in the lectotype of var. *mahensis* the abdomen is in normal distention appearing uniformly blackish. Because of the limited material a dissection was not made of this species.

Dasyhelea scotti (Kieffer), new combination
(Fig. 4h)

Culicoides scotti Kieffer, 1911:341 (♂, ♀; Seychelles; fig. ♀ wing).

Distribution.—Seychelles Islands. SEYCHELLES: Mahé, Beau Vallon, 27 April 1965, Tams and Nye, 3♀♀.

Types.—Described from 4♂♂, 47♀♀ from Mahé, Seychelles: 1♀, Cascade Estate, about 800 feet and over, collected by H. P. Thomasset and H. Scott, October 1908; 4♂♂, 40♀♀, Cascade Estate, about 800–1,500 feet, 1909; 6♀♀, Cascade, marshy ground near sea-level, 20 February 1909. We

have examined 2♂♂, 12♀♀ syntypes, from which we have selected a ♀ bearing the handwritten label "*Culicoides scotti*" as LECTOTYPE, which remains on a pin.

Note.—Two species of *Dasyhelea* were confused in the syntype series of *scotti*; in addition one of the males was a specimen of *Forcipomyia psilonota* (Kieffer). The lectotype is a very small species with dull blackish mesonotum and yellowish scutellum; the wings have abundant, long macrotrichia. We have not examined a male of *scotti*. One female syntype was slide-mounted and the spermatheca and genital sclerotization are shown in Fig. 4h. The spermatheca is moderately small and subspherical with a faintly sclerotized, slender neck. Wing length 0.69 mm; costal ratio 0.52. Six of the remaining pinned syntypes examined are *D. scotti*. The remainder of the syntypes that we examined are an undescribed species which is slightly larger than *scotti* and readily distinguished by its shining reddish-brown mesonotum. Part of the series was labeled in the collection as *scotti* var. *bipunctata* Kieffer, but apparently the name was never published and is now used to name the species.

Dasyhelea bipunctata Wirth and Messersmith, new species
(Fig. 4e, 4f, 4g)

Female Holotype.—Wing length 0.78 mm; breadth 0.36 mm; costal ratio 0.46. Antenna with lengths of segments in proportion of 30-24-24-24-23-23-23-25-26-26-26-26-36; antennal ratio 0.72, segments in more or less a continuous series; last segment without terminal stylet. Palpus not in condition for examination. Thorax brown; mesonotum shining; humeri with extensive yellowish markings; scutellum bright yellow. Legs yellowish, femora slightly darker in midportions. Wing whitish hyaline with well-developed microtrichia on membrane; radial veins infuscated; radial cells slitlike; macrotrichia long and moderately abundant, relatively stout, arranged in lines along veins. Halter white. Abdomen uniformly dark brown; genital sclerotization as in Fig. 4g, no apparent sclerotization anterior to gonopore, but sternal margin with low rounded lobes and bearing a row of 4 prominent bristly setae mesad with some smaller setae laterally. Spermatheca 1, very small, collapsed in holotype but apparently subspherical without neck; measuring 0.032 mm in diameter.

Male Allotype.—Antenna with plume extending up to segment 14; proximal flagellar segments unusually stout and fused; segments 12-14 binodose; 5 distal segments with lengths in proportion of 20-40-40-40-33. Genitalia (Fig. 4e): Ninth sternum with rounded mesal lobe continuous with arch of aedeagus; 9th tergum short and broad, tapering to conspicuous, slender apicolateral processes, caudal margin between them slightly convex. Aedeagus broader than high, with rounded basal arch and a pair of short, slender,

distomesal sclerotized processes. Parameres (Fig. 4f) asymmetrical, basal apodemes stout, distal process sinuate, very slender distally.

Distribution.—Seychelles Islands.

Types.—SEYCHELLES: Holotype, ♀, allotype, ♂, Mahé, Cascade Estate, 1908-1909, H. P. Thomasset and H. Scott (from the syntype series of *Culicoides scotti* Kieffer in the BMNH). Paratypes, 4♀♀, same data.

Dasyhelea tamsi Wirth and Messersmith, new species
(Fig. 4a, 4b, 4c, 4d)

Female Holotype.—Wing length 0.95 mm; breadth 0.42 mm. A small pollinose pale gray species; wing whitish with blackish stigma.

Head: Antenna (Fig. 4a) with lengths of segments in proportion of 28-20-20-20-20-20-21-21-21-22-22-33; antennal ratio 0.70; segments in a continuous series, moniliform proximally to slightly elongated on distal segments; surface of segments conspicuously reticulated; last segment without terminal stylet. Palpus (Fig. 4b) short and stout, lengths of segments in proportion of 28-24-18-18. Mesonotum with 3 broad dark brownish gray longitudinal vittae, humeri extensively pale yellowish gray. Scutellum yellowish. Legs whitish, knee spots blackish. Wing (Fig. 4c) milky whitish, the radial cells forming a dark stigma; costal ratio 0.49; veins forming radial cells greatly strengthened, the 1st radial cell obsolete, the 2nd short with small lumen; macrotrichia long and stout, very sparse, forming lines along the veins, more numerous on distal portion of wing. Halter grayish infuscated. Abdomen grayish brown. Genital sclerotization as in Fig. 4d, with slightly infuscated quadrate median lobe and a slender pair of oblique lateral arms. Spermatheca (Fig. 4d) single, ovoid, tapering to short stout neck; heavily sclerotized; measuring 0.060 by 0.045 mm.

Male.—Unknown.

Distribution.—Seychelles Islands.

Types.—SEYCHELLES: Holotype, ♀, Mahé, Anse aux Pins, 24 May 1972, D. H. Messersmith, at light (Type no. 70672, USNM). Paratypes, 20♀♀, Mahé, Beau Vallon, 27 April 1965, Tams and Nye.

Remarks.—This species is named for W. T. Tams of the British Museum (Natural History) in recognition of the important collection of Ceratopogonidae he and I. W. Nye made in the Seychelles for the British Museum. The whitish hyaline, nearly bare wings with dark stigma and the pale grayish pollinosity of the vittate mesonotum readily characterize the species.

Culicoides (Meijerehelea) leucostictus Kieffer

Culicoides leucostictus Kieffer, 1911:340 (♀; Seychelles: fig. wing); Edwards, 1922:163 (notes).

Culicoides praetermissus Carter, Ingram, and Macfie, 1920:240 (♂; Gold Coast; fig. wing); Clastrier, 1958:203 (redescribed: Senegal; figs.);

Khamala and Kettle, 1971:67 (notes; figs.; rec. Kenya, Uganda; syn.: *egypti*). NEW SYNONYMY.

Culicoides distinctipennis var. *pratermissus* Carter, Ingram, and Macfie; Fiedler, 1951:5 (new status, only a variety).

Culicoides distinctipennis var. *egypti* Macfie, 1924:66 (♀; Egypt); de Meillon, 1943:100 (var. of *distinctipennis*). NEW SYNONYMY.

Culicoides egypti Macfie; Macfie, 1943:154 (notes; status).

Distribution.—Widespread in Ethiopian Region. SEYCHELLES: Mahé, Reef Hotel Golf Course, 22 May 1972, D. H. Messersmith, black light, 1♂, 9♀♀. Mahé, Beau Vallon, March–April 1965, Tams and Nye, 16♂♂, 25♀♀. Mahé, Cascade, 10 March 1965, Tams and Nye, 1♂, 2♀♀.

Remarks.—This species closely resembles *C. distinctipennis* Austen except for the presence of a distinct, separate, small pale spot in cell R5 just behind and slightly distad of the pale spot lying at the end of the costa. The male genitalia of *leucostictus* differ from those of *distinctipennis* mainly in the greater length of the aedeagus and the longer midportion (stem) of the parameres. The Oriental species *histrion* Johannsen is also very similar to *leucostictus* but lacks a distal sensory tuft on antennal segment 15 and the male aedeagus is slender and truncated distally, lacking the caplike terminal papilla. The Oriental *C. guttifer* (de Meijere) differs in wing pattern and the spermatheca is shaped differently.

Culicoides (? Subgenus) *kusaiensis* Tokunaga

Culicoides kusaiensis Tokunaga, 1940:215 (♂, ♀; Caroline Is.; figs.); Lambrecht, 1970:1777 (notes, Seychelles records).

Distribution.—Micronesia, Malaya, Borneo, Seychelles Islands. SEYCHELLES: Mahé, Beau Vallon, 30 March, 18–27 April 1965, Tams and Nye, 4♂♂, 1♀. Mahé, Cascade, 10 March 1965, Tams and Nye, 1♂, 3♀♀.

Remarks.—Lambrecht (1970) reported the remarkable distribution of this species, ranging from the Caroline Islands through Malaysia to the Seychelles. Lambrecht took 2 females biting man on the beach at Grand Anse, 22 April 1969.

Alluaudomyia marmorata (Carter, Ingram and Macfie)

Prionognathus marmoratus Carter, Ingram and Macfie, 1921:312 (♂, ♀; Gold Coast; figs.).

Alluaudomyia marmorata (Carter, Ingram, and Macfie); de Meillon, 1939:8 (combination; in key).

Distribution.—Widespread in Ethiopian Region. SEYCHELLES: Mahé, Beau Vallon, 25 April 1965, Tams and Nye, 3♂♂.

Stilobezzia areolaris (Kieffer)

Sphaeromyias areolaris Kieffer, 1911:345 (♀; Seychelles; fig. wing, tarsus).
Stilobezzia areolaris (Kieffer); Das Gupta and Wirth, 1968:138 (combination).

Distribution.—Seychelles Islands. SEYCHELLES: No locality, February–March 1965, Tams and Nye, 7 ♂♂, 1 ♀.

List of the Known Ceratopogonidae of the Seychelles

Subfamily Leptoconopinae

Leptoconops (*Styloconops*) *spinosifrons* (Carter) Lambrecht, 1970

Subfamily Forcipomyiinae

Atrichopogon lampronotus (Kieffer) Kieffer, 1911
Atrichopogon trichotomma (Kieffer) Kieffer, 1911
Forcipomyia (*Euprojoannisia*) *pilonota* (Kieffer) Kieffer, 1911
Forcipomyia (*Forcipomyia*) *biannulata* (Ingram and Macfie) New Record
Forcipomyia (*Lasiohelea*) *mahensis* (Kieffer) Kieffer, 1911
Forcipomyia (*Lepidohelea*) *chrysolopha* (Kieffer) Kieffer, 1911
Forcipomyia (*Microhelea*) *fuliginosa* (Meigen) New Record
Forcipomyia (*Schizoforcipomyia*) *borbonica* (Clastrier) New Record
Forcipomyia (*Thyridomyia*) *falcinellus* (Kieffer) Kieffer 1911

Subfamily Dasyheleinae

Dasyhelea aurantiaca (Kieffer) Kieffer 1911
Dasyhelea scotti (Kieffer) Kieffer 1911
Dasyhelea seychellensis (Kieffer) Kieffer 1911
Dasyhelea tamsi, new species New Record
Dasyhelea bipunctata, new species New Record

Subfamily Ceratopogoninae

Culicoides kusaiensis Tokunaga Lambrecht, 1970
Culicoides leucostictus Kieffer Kieffer, 1911
Alluaudomyia marmorata (Carter, Ingram and Macfie) New Record
Monohelea pulchripennis (Kieffer) Kieffer, 1911
Stilobezzia areolaris (Kieffer) Kieffer, 1911
Serromyia festiva Kieffer Kieffer, 1911
Hebetula hexacantha (Kieffer) Kieffer, 1911

<i>Nilobezzia scotti</i> (Kieffer)	Kieffer, 1911
<i>Bezzia ornatissima</i> (Kieffer)	Kieffer, 1911
<i>Bezzia rufipes</i> (Kieffer)	Kieffer, 1911
<i>Bezzia seychelleana</i> (Kieffer)	Kieffer, 1911

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Footnote

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A NEW SPECIES OF *DOMINICOMYIA* FROM BRASIL
(DIPTERA: DOLICHOPODIDAE)

Harold Robinson

Abstract.—A second species of *Dominicomomyia*, *D. brasiliensis*, is described as new and is compared with *D. chrysotimoides* H. Robinson of the Lesser Antilles.

A small collection of Dolichopodidae from Bahia, Brasil was received recently from John A. Winder at the Biological Control Station in Curitiba, Paraná. The series of potentially interesting specimens included three species of *Condylostylus*, two species of *Chrysotus* one of which is similar to *C. crosbyi* V. Duzee of North America, one species of *Diaphorus* with a yellow base on the abdomen, one species of *Xanthina*, *Micromorphus albipes* Zett., and a close relative of *Medetera crassicauda* H. Robinson. The packaging of the material in alcohol in small vials and the legal restrictions on dealing with recent collections from Brasil were sufficient to discourage any serious efforts at determination. Thanks to the efforts of museum preparators the material has been placed on pins and one species proves to be of sufficient interest and in sufficient quantity to warrant further study.

The genus *Dominicomomyia* was described on the basis of a single species from the island of Dominica in the Lesser Antilles (Robinson, 1975). The genus was placed in the Medeterinae and seemed to have close relationship only to another monotypic genus, *Cryptopygiella*, described at the same time from Dominica. One of the species in the brasilian collection is a second species of *Dominicomomyia* which allows a confirmation of various generic traits, a correction of one described feature of the female genitalia, and offers some insight into the kinds of specific variations that might be expected in the genus.

Dominicomomyia brasiliensis H. Robinson, new species
(Fig. 1-3)

Male.—Length 1.8 mm; wing 1.9 mm by 0.7 mm; stout, mostly brownish with slight metallic reflections; setae dark with pale reflections. Face and front dark reddish brown with slight gray pollen, face 2× as wide above as antennal segment 3, sides nearly straight, transverse suture weak. Palpus brown with a few smaller setae and a larger apical seta; proboscis brown, pseudotracheae geminately sclerotized; hypopharynx (Fig. 3) with large tooth ventrally. Antennae dark brown, segment 3 hemispherical. Hind surface of head metallic bluish; lower postocular setae pale. Thorax

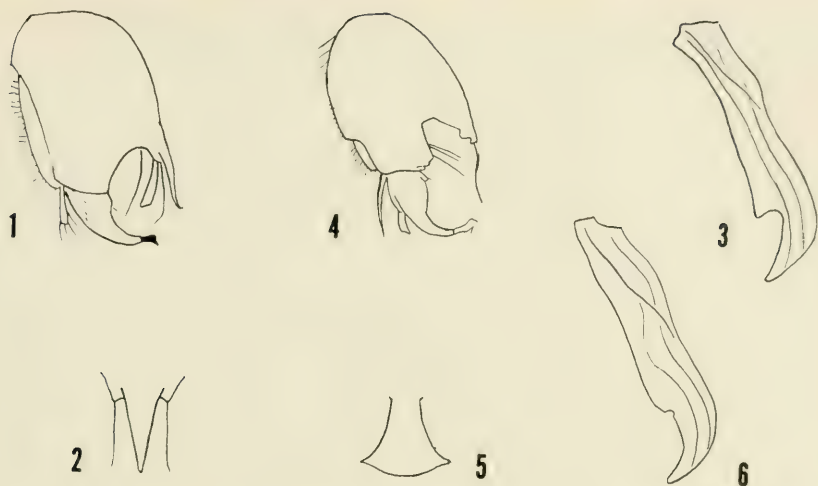


Fig. 1-3. *Domicomymia brasiliensis*. 1, hypopygium of male. 2, ventral lobe of hypopygium. 3, hypopharynx, lateral view. Fig. 4-6. *D. chrysotimoides*. 4, hypopygium of male. 5, ventral lobe of hypopygium. 6, hypopharynx, lateral view.

brownish, mesoscutum and scutellum with metallic bluish or violet reflections; about 7 pairs of acrostichals; 5 pairs of large dorsocentrals; posterior slope flattened; scutellum with 1 pair of bristles, minute seta on lateral margin. Legs yellow with bases of middle and hind coxae and 5th segments of tarsi slightly brownish. Femora without preapicals. Fore and hind tibiae plain; middle tibia with small anterodorsal near basal $\frac{1}{4}$, 3 small apicals. Relative lengths of leg segments from base in mm as follows: Leg I, coxa 0.4, femur 0.55, tibia 0.57, segments of tarsus 0.25-0.18-0.15-0.11-0.10; leg II, femur 0.68, tibia 0.59, segments of tarsus 0.34-0.27-0.16-0.11-0.07; leg III, femur 0.68, tibia 0.90, segments of tarsus 0.14-0.35-0.16-0.11-0.10. Wing oblong-oval, clear; veins yellowish. Veins 2, 3, and 4 all nearly straight and parallel beyond middle of wing, vein 3 slightly nearer 2 in middle of last part, with scarcely perceptible forward turn at tip, ending slightly before wing apex, vein 4 ending slightly farther behind wing apex. Crossvein perpendicular to base of vein 4, nearly $\frac{1}{2}$ as long as last of vein 5. Hairs of calypter pale; halter pale. Abdomen with tergites pale brownish, mostly without metallic reflections. Hypopygium (Fig. 1, 2) small, ca. 0.35 mm long, brown; apical appendage brown, tapering, curving toward venter with minute appendage at tip, not noticeably trilobed at base; smaller appendage not tapering, bearing fringe of hairs apically and ventrally; dorsal surface of capsule with sinus extending nearly to base, filled with pale pubescent cushion; mid-dorsal surface of capsule with

narrowly triangular brown projection, without differentiated tip, with small setiferous lobe on each side at base.

Female.—Head, thorax, legs, wing and preabdomen essentially as in male.

Type-data.—Holotype ♂, allotype ♀, 4♂♂ and 4♀♀ paratypes from Brasil: Bahia, CEPLAC, Itabuna; 3♂♂ and 1♀ paratypes from rotting cacao pods, 1971–72, others from rotting banana stem, 17 June 1973; all John A. Winder; holotype eventually to be deposited in Brasil, others in the U.S. National Museum.

Remarks.—The new species can be distinguished initially by the brownish color of the body and antennae. The Dominican species, *D. chrysotimoides* H. Robinson, has a more metallic green thorax and has yellow antennae. More significant differences are seen in the hypopygium of the male. The lateral aspect of the hypopygium is superficially similar but the new species has the sinus of the dorsal surface much deeper, reaching more than three-fourths the distance to the base of the capsule, the median-ventral projection is narrowly tapering and totally brown without a differentiated tip, the apical curved armature is not obviously tricornute at the base, and the small appendage from the base of the armature is broader and fringed instead of simple and bristle-like. Differences elsewhere include the large tooth instead of a small notch ventrally on the hypopharynx and the very slightly but consistently more flexed last part of the third wing vein. The collection data suggests the habitat might also differ in the two species, the Dominican species was collected on palm trunks and cement walls while the Brazilian species is from rotting vegetable material.

The original generic description erred in citing only a single pair of dornen on the female genitalia. Reexamination shows a small crest which is barely visible. A crest is more obvious on material of the new species with four or five dornen on each side. The presence of a crest is of significance since other characters still indicate the genus is in the subfamily Medeterinae where such crests are usually reduced or absent.

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A NEW SPECIES OF FOSSIL ISOPTERA (KALOTERMITIDAE)
FROM THE RUBY RIVER BASIN (OLIGOCENE)
OF SOUTHWESTERN MONTANA¹

Standley E. Lewis

Abstract.—This is the first fossil isopteran of the family Kalotermitidae to be found from the Oligocene sediments of the Ruby River Basin of Montana. The specimen is provisionally placed in the genus *Prokalotermes* with the new specific name *alderensis*.

One specimen of an imago termite fossil (Isoptera: Kalotermitidae) was discovered from the paper shale deposits of the Ruby River Basin of SW Montana. This specimen, which is provisionally placed in the genus *Prokalotermes* Emerson, represents the first member of the genus and family to be described from the Ruby River Basin. Another species of *Prokalotermes*, *P. hageni* (Schudder), was described from the Oligocene shales of Florissant, Colorado (Emerson, 1969). Lewis (1973) reported a fossil termite of the family Hodotermitidae from the same locality.

The specimen was found in layered shales of Oligocene age between Peterson and Mormon Creeks, sec. 23 T.7S., R.5W., Madison County, Montana. The digging sites are located about 13 mi from the town of Alder. A brief description of the geological history of this region can be found in a previous taxonomic work from this area (Lewis, 1971).

This fossil impression is represented by portions of the body, parts of the forewings, and a small portion of the legs. The two impressions present are reverse images of the same individual. The shale rock seems to be a volcanic ash deposit with a similar appearance to the Florissant Shales of Colorado. There is no doubt that this specimen belongs to the family Kalotermitidae of the order Isoptera. The Tertiary fossil species of this family has been recently revised by Emerson (1969).

Prokalotermes (?) *alderensis* Lewis, new species
(Fig. 1)

Imago.—Color of head, pronotum, wings scales, and tergites dark brown but possibly modified by preservation. Total length of body 12.4 mm. Head with rather rounded sides. Y-suture not distinct. Eyes moderate in size and slightly prominent at sides. Visible length of eye (about 0.69 mm) medium in size and similar in proportion to most genera of the family. Presence and position of ocelli not clear. Antenna present with 16-17 articles visible. Dentition of left mandible not clear, but resembling that of *Prokalotermes hageni* (Emerson, 1969, Fig 3A). Proportion of size of

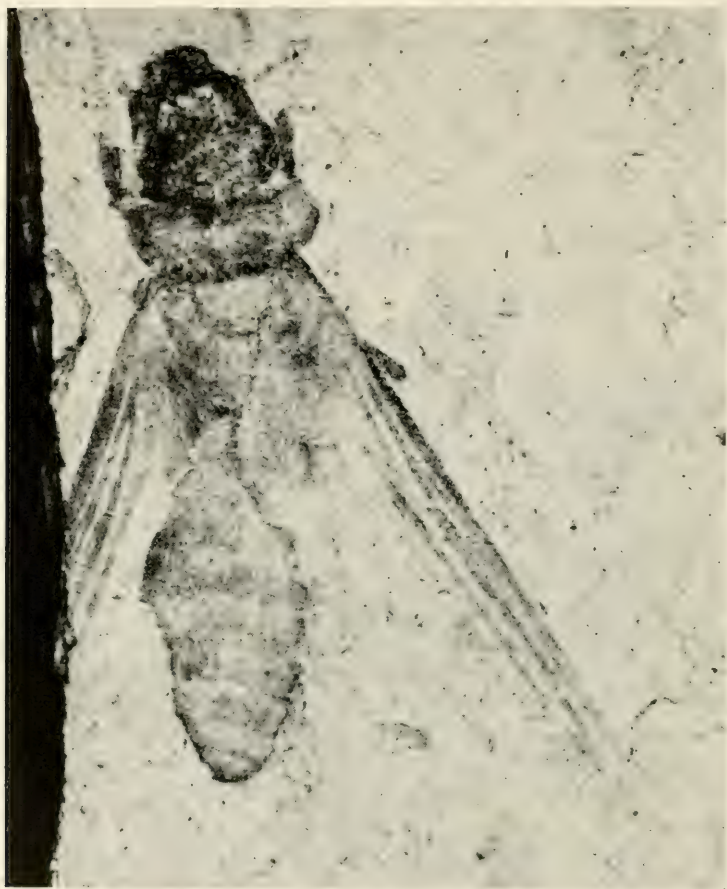


Fig. 1. Photograph of *Prokalotermes*(?) *alderensis* from the Ruby River Basin (Oligocene) of S.W. Montana (8.3 $\times$).

apical and marginal teeth in left mandible not sufficiently distinct to compare accurately with *P. hageni* (Emerson, 1969, Figs. 3A and 5A). Width and length of head at broadest points 2.4 mm. Pronotum wider than head, with distinct median longitudinal line; front margin slightly concave; side margins with convex arch; front angles sharply rounded; hind angles very gradual; hind margin with slight center notch. Pronotum 3.2 mm in length and 1.4 mm in width at longest and widest points. One front tibia visible with possibly 3 proportionally long spurs. End of tarsus, claws and arolium not visible. Tarsus with what appears to be 4 articles. Costal margin of forewing scale almost flat. Humeral suture of forewing flatly curved. No short Sc visible in forewing beyond humeral suture. R_1 , R_2 ,

R_3 and R_s possibly visible at suture. M not clear, with its position in middle of wing not certain. Confusion of venation may be due to overlap of forewing and hindwing in several places. Length of wing present 10.7 mm. Abdomen incomplete, but clear. Total width and length not determinable. Eight tergites visible, but styli or cerci not seen.

Holotype.—No. B-3. Described from an incomplete adult termite. Found near Alder, Montana, by Herman F. Becker, 196(?) . Upper Oligocene sediment of the Ruby River Basin, reverse present. Specimen presently maintained by S. E. Lewis at St. Cloud State University. When work on entire fossil collection is completed, this specimen will be deposited in the American Museum of Natural History, New York.

Comments

On the basis of the costal margin of the forewing scale, the humeral suture, the dentition of the left mandible and shape of the pronotum, this specimen most clearly resembles the Florissant species *Prokalotermes hageni*. The flat curve of the costal margin of the forewing scale clearly is similar to that of *P. hageni* and is distinctly flatter than the costal margin of the forewing scale of *Proelectrotermes berendtii* (Pictet) or *Proelectrotermes fodinae* (Scudder) also from the Florissant shales (Emerson, 1969, Figs. 3, 4, and 5).

The length of the costal margin of the forewing scale is about 1.83 mm, considerably longer than *Prokalotermes hageni*, with scale length of 1.10 mm, and *Proelectrotermes fodinae*, at 1.10–1.22 mm. The humeral suture is flatly curved as in *Prokalotermes* and *Proelectrotermes* and not as much arched as in *Electrotermes* von Rosen and most other genera of the Kalo-termitidae with the exception of *Postelectrotermes* Krishna, which has a slightly more arched suture (Krishna, 1961).

As previously mentioned, the proportion of the size of the apical and marginal teeth in the left mandible are not sufficiently distinct to compare accurately with Emerson's studies (1969). It seems that the apical tooth is similar to that of *P. hageni*, whereas the marginal teeth and the angle between them are similar to *P. fodinae*, thus giving one a more transitional specimen.

The pronotum with its distinct median longitudinal line, slightly concave front margin, convexly arched side margins, sharply rounded front angles and gradual hind angles are all similar to *Prokalotermes hageni*. Although the size does resemble that of *Proelectrotermes berendtii*, the overall comparison favors that of *P. hageni*.

In comparing the fossil kalotermitids from the Oligocene of North America, one is certainly justified in stating that the Ruby River specimen is larger than those of Florissant. This difference is sufficient for a species

difference, and the wider pronotum in relation to head may indicate a generic difference, but size differences, especially those of shale specimens with some distortion and inaccuracies, should not be used for generic distinction without many other characteristics associated with them.

Based on the information that is obtainable from this specimen, it is felt that this is a new species possibly belonging to *Prokalotermes* but also possibly a new genus of primitive Kalotermitidae (personal communication, Emerson, 1975). I do not believe a new genus should be described for this specimen at this time. The new species is now placed provisionally in the genus *Prokalotermes* with the specific name of *alderensis* until more material is gathered and studied.

Acknowledgment

I am indebted to Professor Emeritus Alfred E. Emerson for his help and comments in the taxonomic placement and in the preparation of the description of this fossil termite.

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Footnote

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STUDIES ON IDIOCERINAE LEAFHOPPERS, XVII:
THREE NEW NEOTROPICAL GENERA
(HOMOPTERA: CICADELLIDAE)

J. Maldonado-Capriles

Abstract.—*Parachunroides wandae*, *Adchunroides triangularis*, *Rotundicerus luteus* are new genera and new species of Idiocerinae leafhoppers and are described from specimens from Guyana, South America. The new genera and species are illustrated and compared with allied taxa.

Among material of idiocerine leafhoppers sent to me for identification by Dr. W. J. Knight, from the British Museum (Natural History) (BMNH), several undescribed genera and species were found; three of which are described below. Two of these are somewhat similar to *Chunroides* Evans and therefore are compared with it. Because *Optocerus* Freytag has somewhat similar coloration it is also considered in the comparative notes.

The types are deposited in BMNH and in my collection (JMC). In the descriptions that follow, 12.5 micrometer units are equivalent to 1 mm. All the specimens come from Guyana, formerly British Guiana.

Parachunroides Maldonado-Capriles, new genus

Type-species: *Parachunroides wandae*, n. sp.

Head, pronotum, and scutellum mahogany red, densely spotted with small cream-yellow spots of different sizes (Fig. 12); gena and lora less conspicuously spotted; postclypeus and anteclypeus stramineous, spotted with brown; scutellum with light colored triangular area near each basal angle. Forewings semitransparent, with a brownish tinge; veins mahogany red, conspicuously spotted with cream yellow. Femora reddish brown, tibiae and abdominal sterna yellowish brown.

Vertex short, slightly shorter medianly than next to eye, about 6× as wide as long, finely shagreen. Eyes contiguous to hind margin of head. Head wider than pronotum; face wider across eyes than long, somewhat flattened; lateral margins of postclypeus arcuate; upper frontal suture curved upward to ocellus. Ocelli nearly as far apart as distance from ocellus to eye. Lora short, semicircular, slightly elevated. Anteclypeus subquadrangular, slightly longer than wide basally, apex notched. Genae with margin slightly concave at midlength. Filament of antenna hairlike. Tibiae quadrangular in cross-section; strongly spinulose on 3 margins, inner-upper margin with about 30 hairlike spines. Scutellum longer than head

and pronotum together. Forewing longer than abdomen; with 4 apical, 2 subapical, and one discal cell; 2nd costal present; outer apical extending basad along outer margin of outer anteapical (Fig. 1).

Female Genitalia.—VII sternum slightly longer than VI (3:2.5), caudal margin broadly and shallowly concave; pygofer slightly longer than abdominal sterna together, bare; ovipositor narrow, surpassing pygofers.

Male Genitalia (Figs. 2-10).—Valve flattened laterally, apical $\frac{1}{2}$ semi-circular, long-haired along upper margin, on ventral aspect triangular. Style with lower outer ledge of caudal end absent, fine hairs in its place. Aedeagus with a wide small base; shaft long, slender, curved cephalad. Pygofer semicircular, inner margin entire. Connective inverted Y-shaped. Tenth tergum short, hoodlike. Length 5.5-5.7 mm.

The mottled or spotted coloration of the head and pronotum of *Parachunroides* n. gen., *Optocerus* Freytag, *Adchunroides* n. gen., and *Chunroides* Evans set them apart from other American genera. These four genera can be separated by the following key:

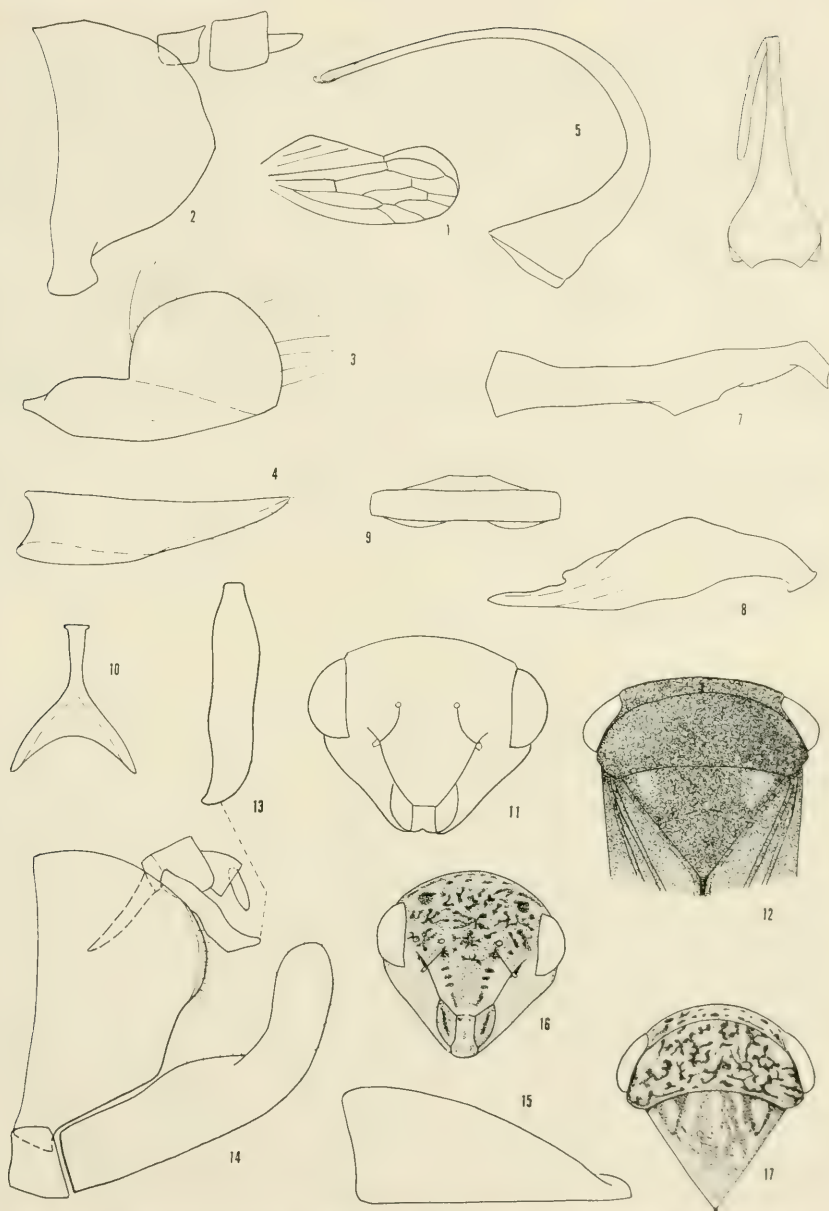
1. Small, under 2.6 mm; with a strong seta laterally below each eye;
outer apical cell pedunculate *Optocerus* Freytag
- Longer, over 4.5 mm; without such seta below each eye; outer apical
cell not pedunculate 2
2. Face convex; ocelli set apart at $2\times$ the distance from ocellus to
eye *Adchunroides*, n. gen.
- Face flattened; ocelli set apart at nearly the same distance to eye 3
3. Outer apical cell about as long as 3rd, their bases nearly in line;
apex of scutellum slightly swollen, raised; ocellar area sunken *Chunroides* Evans
- Outer apical cell much longer than 3rd, its angular base far basad of
3rd; apex of scutellum not swollen; ocellar area not sunken *Parachunroides*, n. gen.

The genitalia of these genera also set them apart. The cross-section of the tibiae is rectangular in *Parachunroides* and oval in the other 3 genera.

Parachunroides wandae Maldonado-Capriles, new species
(Figs. 1-12)

Male.—Color of head, pronotum, forewings, scutellum, and abdomen as described for genus. Mesopleura brown, black oval area above coxa; metapleura brownish. Profemur black on basal $\frac{1}{2}$, apical $\frac{1}{2}$ and meso- and metafemur reddish brown. Tibiae yellowish brown; base of spines on metafemur yellowish. Abdominal sterna with apical margin yellowish.

Vertex slightly shorter medianly than next to eyes (1.5:2); pronotum about $3.5\times$ as wide as long (27:8), posterior margin broadly and shallowly



Figs. 1-12. *Parachunroides wandae*. 1, forewing. 2, pygofer and anal segments, lateral. 3, plate, lateral. 4, plate, ventral. 5, aedeagus, lateral. 6, aedeagus, caudal. 7, style, lateral. 8, style, dorsal. 9, valve, ventral. 10, connective, dorsal. 11, face, outline. 12, anterior half, dorsal. Figs. 13-17. *Adchunroides triangularis*. 13, appendix of pygofer, caudal. 14, genital capsule, lateral. 15, plate, ventral. 16, face. 17, head, pronotum, scutellum, dorsal.

concave; scutellum $\frac{3}{4}$ as long as wide (15:20). Face flattened, wider across eyes than long (29:25); lateral margins of postclypeus and lateral frontal sutures as described for genus; ocelli set apart at a distance slightly longer than from ocellus to eye (7:6). Anteclypeus with apex concave, longer than wide apically (5:3). Metatibia with 2 outer rows of spines consisting of 7 semidecumbent strong spines. Genitalia as in Figs. 2 to 10. Length 5.5 mm.

Female.—Coloration and shape mostly as in male. Vertex with anterior margin flatter than in male, $3\times$ longer close to inner margin of eye than medianly (3:1). Anteclypeus as in male, slightly longer than wide (5:4). Postclypeus and shape and spines of legs as in male. Seventh sternum with posterior margin broadly concave; ovipositor surpassing pygofer by $3\times$ its width and almost reaching apex of forewing. Length 5.7 mm.

Holotype.— δ , British Guiana, Katari Sources, January–February 1936, C. A. Hudson coll. BM-1936-360. *Allotype*.— η , New River, c 750 ft, 26 February 1936, C. A. Hudson. Both in BMNH.

Etymology.—I have named this species after my student-assistant Miss Wanda Beauchamp.

Adchunroides Maldonado-Capriles, new genus

Type-species: *Adchunroides triangularis*, n. sp.

Vertex and pronotum stramineous, densely mottled with reddish brown, anteclypeus, gena, postclypeus, and lora stramineous, the 1st 2 unmarked. Scutellum stramineous, triangular spot near each basal angle with brown margins; disc ornamented with light brown. Forewings semitransparent, with a brownish tinge, deeper than base color of pronotum, scutellum and head; costal area yellowish before margin, veins brown. Legs light brown; abdominal sterna brownish, apical margin slightly lighter.

Head with anterior and posterior margins parallel, curved; vertex about $6.5\times$ as wide as long. Pronotum $2.5\times$ as wide as long, posterior margin nearly straight. Scutellum wider than long; slightly longer than head and pronotum combined. Face slightly longer than wide across eyes. Anteclypeus bellshaped, slightly longer than wide apically. Postclypeus with lateral margins slightly angled; upper lateral margin straight, reaching to below ocellus of corresponding side; ocelli apart at about $2\times$ the distance from ocellus to eye. Forewing with 4 apical, 2 anteapical, and 1 discal cell; no 2nd costal cell. Tibiae oval in cross-section. Metatibia strongly spinulose on 3 margins, inner-upper margin with about 30 hair-like spines.

Female Genitalia.—VII sternum slightly longer than VI, broadly and

shallowly concave; pygofer as long as abdominal sterna together; ovipositor narrow, surpassing pygofer by a length equal to its width.

Male Genitalia.—Valve flattened laterally, deeper basally than apically, short pilosity along apical $\frac{1}{2}$ of upper margin; in ventral aspect triangular. Style with apical lower outer shelf strongly upcurved. Aedeagus slender, slightly curved cephalad, with moderately large socle as seen in lateral aspect. Pygofer with upper-inner margin globose, membranose; with a straight sclerotized appendix above membranous area. Tenth tergum produced ventro-cephalad as a single pointed projection. Connective triangular, flattened dorsoventrally, with short vertical knob where it meets the aedeagus. Length 4.6–5.00 mm.

See discussion under *Parachunroides* for characters to separate *Adchunroides* from allied genera. The name of the genus suggests its resemblance to *Chunroides*. The appendix of the pygofer is slender, paddle like, and projects from the dorsal-caudal margin in *Chunroides*, whereas it is heavy, straight, and projects from above the membranous apical area in *Adchunroides*.

Adchunroides triangularis Maldonado-Capriles, new species
(Figs. 13–25)

Male.—Coloration of head, pronotum, forewings, legs, abdominal sterna, and scutellum as described for genus. Two blackish brown spots high on crown, closer to eyes than ocelli; postclypeus with 2 incomplete rows of brown spots; 1st segment of beak dark brown.

Head with vertex $6.5\times$ as wide as long (13:2); pronotum about $2.5\times$ as wide as long (21:8). Face very slightly longer than wide across eyes (24:23). Anteclypeus slightly longer than wide apically (5:4); ocelli apart about $2\times$ the distance from ocellus to eye (8:4). Scutellum $1.5\times$ as wide as long (16:11), as in Fig. 17. Spines of margins of metatibia as follows: Upper-outer with 6 vertical strong spines, upper-inner with 15 fine subvertical, lower-outer with 10 fine; and lower-inner with 35–40 hairlike spines. Length 4.7 mm. Genitalia as in Figs. 14, 15 and 18–24; valve with apical margin slightly convex.

Female.—Coloration as in male; markings on postclypeus more abundant and better defined; abdominal sterna stramineous; ovipositor light brown. Head with vertex $7\times$ as wide as long (14:2); pronotum about $2.5\times$ as wide as long (24:10); scutellum about $1.5\times$ as wide as long (18:13); face across eyes as wide as long (26:26). Genital segments as described for genus. Length 5.0 mm.

Holotype.—♂, British Guiana, New River, 750 ft. March 26–April 2, 1938. C. A. Hudson coll., in BMNH. *Allotype*.—♀, same data. Paratypes 4♀♀:



Figs. 18-25. *Adchunroides triangularis*. 18, aedeagus, lateral. 19, aedeagus, caudal. 20, style, lateral. 21, style, apex, dorsal. 22, connective, dorsal. 23, connective, lateral. 24, valve, ventral. 25, forewing. Figs. 26-35, *Rotundicerus luteus*. 26, forewing. 27, aedeagus, caudal. 28, aedeagus, lateral. 29, connective and style, dorsal. 30, apex of style, from behind. 31, style, lateral. 32, genital capsule, lateral. 33, detail of genital capsule, caudal, larger scale. 34, face. 35, head, pronotum, scutellum, dorsal.

1♀, Katari sources, January–February 1936, in JMC; 3♀♀—2 same data as holotype, 1 from Oronoque and New River Heads, in BMNH.

See discussion under *Parachunroides* for characters to separate *Adchunroides* from allied genera.

Etymology.—The trivial name makes reference to the triangular spots on the scutellum.

Rotundicerus Maldonado-Capriles, new genus

Type-species: *Rotundicerus luteus*, n. sp.

Head, pronotum, and scutellum mostly yellow. Forewings translucent with a brownish tinge, veins mostly brown; costal and claval margins reddish. Legs and abdominal sterna brownish.

Head globose; vertex finely shagreen; anterior and posterior margins strongly curved, parallel; vertex about $7.5\times$ as wide as long medianly. Face slightly wider across eyes than long; postclypeus with lateral margins angled at about midlength; lateral frontal sutures short, pointing to above level of ocellus of other side. Ocelli set apart at a distance about equal to distance from ocellus to eye. Anteclypeus bellshaped, slightly longer than wide apically. Lora flat, semicircular, short. Gena flattened, margin nearly straight. Pronotum about $2.5\times$ as wide as long, posterior margin broadly concave. Scutellum slightly inflated basically and apically; slightly longer than head and pronotum together. Forewing longer than abdomen; with 4 apical, 2 anteapical, and 1 discal cell; 2nd–4th apical cells arising from apex of outer anteapical, inner anteapical not ending in a cross vein, its longitudinal veins meeting.

Female Genitalia.—VII sternum slightly longer than VI, caudal margin straight; pygofer about as long as abdominal sterna together, bare; ovipositor narrow, slender, surpassing pygofer by $2\times$ its width.

Male Genitalia.—Valve flattened, in lateral aspect deeper apically than basally, in ventral aspect triangular; long, hairy on apical $\frac{1}{2}$ of upper margin. Style as in Figs. 29–31. Aedeagus straight, without socle, caudal side on apical $\frac{1}{2}$ with scaly appearance. Tenth tergum short, sides produced ventrad. Pygofer with an apical membranous area ending on a small knob-like structure. Connective triangular. Last sternum rectangular. Length 4.7–4.8 mm.

The shape of the inner anteapical and the first apical cell (Fig. 26), the globose head, and the genitalia, especially the membranous area of the pygofer, separate this genus from other idiocerine genera. The Ethiopian genus *Rotifunkia* has a more extensive membranous area on the pygofer and the rest of the genitalia is different.

Etymology.—The generic name makes reference to the somewhat globose

head and ends with *cerus* a particle, meaning antenna, commonly used in the names of idiocerine genera.

Rotundicerus luteus Maldonado-Capriles, new species
(Figs. 26-35)

Male.—Coloration of head and pronotum yellow; gena yellowish; anteclypeus narrowly dark brown apically; scutellum greenish yellow, lighter than pronotum, at about midlength of lateral margin and apically with small brownish spot. Pronotum laterally and legs stramineous or pale brownish; spines along margins of metatibia brown, with costal margin reddish on basal $\frac{2}{3}$, a small brown area at end of reddish area; apical $\frac{1}{2}$ of 2nd costal and contiguous $\frac{1}{3}$ of 4th apical cell almost hyaline, much lighter than other cells. Inner margin of clavus reddish; apical veins of brachial cell whitish.

Vertex $7.5\times$ as wide as long medianly (15:2). Face slightly wider across eyes than long (25:24). Postclypeus and ocelli set apart slightly more than distance from ocellus to eye (6:5). Anteclypeus slightly longer than wide apically (5.5:5). Pronotum over $2\times$ as wide as long medianly (22:10). Scutellum over $1.5\times$ as wide as long (17:12). Spines on margins of metatibia as follows: lower-outer with 6 strong spines, upper-outer with 14 finer spines, lower-inner with 8 fine spines, and upper-inner with 30-35 hairlike spines. Length 4.8 mm. Male genitalia as in Figs. 28 to 33.

Female.—Coloration and shape much as in male. Vertex $7.5\times$ as wide as long medianly (15:2). Pronotum slightly less than $2.5\times$ as wide as long (23:10); scutellum about $1.5\times$ as wide as long (17:13), face slightly wider than long (25:24); postclypeus slightly longer than wide (6:5). Seventh sternum with posterior margin slightly convex; ovipositor surpassing pygofer by $2.5\times$ its width. Length 4.9 mm.

Holotype.— δ , British Guiana, Katari sources, January-February 1936, G. A. Hudson collector, BM 1936-360, in the BMNH. *Allotype*.— φ , same data. *Paratypes*.—1 δ , same data, in JMC; 1 δ , N. River, August 1934, Hudson collector. The contrasting yellow anterior parts of the body and the brown forewings with reddish margins easily identify this species. Two other Neotropical species, *Idiocerus flavidus* Osborn and *I. maricensis* Caldwell, have similar yellow and brown contrasting areas, but both lack reddish areas on the forewing.

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BIOLOGY OF SNAIL-KILLING FLIES (*SEPEDON*) FROM
SOUTHEAST ASIA (DIPTERA: SCIOMYZIDAE)

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Abstract.—Life cycle information is presented for five species of *Sepedon* (Diptera: Sciomyzidae) from southeast Asia. The aquatic larvae of all species (*Sepedon ferruginosa* Wiedemann, *S. plumbella* Wiedemann, *S. senex* Wiedemann, *S. spangleri* O. Beaver, and *S. aenescens* Wiedemann) are found in various types of marsh and pond habitats. All are predatory on aquatic, pulmonate snails, especially *Gyraulus bakeri* Brandt, *G. convexiusculus* Hutton, *Indoplanorbis exustus* Deshayes, and *Lymnaea (Radix) auricularia swinhoei* H. Adam. In the laboratory, they also fed on crushed operculate snails of three species (*Hydrobiodes nassa* Theobald, *Idiopoma ingallsiana* Lea, and *I. pilosa* (Reeve)). Duration of incubation periods and of all three larval stadia, periods within the puparium, and preoviposition periods observed during laboratory rearings of all five species in Thailand are presented. New morphological characters to distinguish adults of *Sepedon plumbella* and *S. senex* are described.

Although sciomyzid larvae of many species are known to be snail killers (Berg, 1961), relatively little is known about the habits and ecological relationships of tropical species of Sciomyzidae. This is particularly unfortunate because increasing problems with snails, especially schistosomiasis and other snail-borne diseases of man and domestic animals, are concentrated in the tropics and subtropics. Thus Sciomyzidae (or marsh flies) adapted for life in the tropics may prove particularly useful biological control agents (Berg, 1973). However, they cannot be so utilized until the habitat requirements, preferred prey species, and other important ecological factors affecting both adults and larvae are understood well enough so that we know which species can be used against each vector snail in the various areas where snail-borne diseases are problems.

The paucity of knowledge about the marsh flies of warm regions is illustrated by the situation in southeast Asia. Although these flies have been mentioned several times in biological literature, most references to them are fragmentary, and the Sciomyzidae of this region remain relatively poorly known. Notes on Sciomyzidae collected in rice fields have been written by Yasumatsu (1967) and Yano (1968), and a key to species occurring in rice fields was presented by Nishida and Torii (1970). Papers on the biology and immature stages of *Sepedon* of that region include a life history of *S. aenescens* Wiedemann (Nagatomi and Kushigemachi, 1965), a description of its eggs (Nagatomi and Tanaka, 1967), and some observa-

tions on its overwintering (ChannaBasavanna and Yano, 1969) (as *S. sauteri* Hendel in all 3 papers). Bhuangprakone and Areekul (1973) discussed the biology of *S. plumbella* Wiedemann, particularly survival on different species of snails, snail-killing ability, and prey preference of larvae. Nagatomi and Kushigemachi (1965), Yasumatsu (1967), and Yano (1975) have stated that *S. aenescens* plays an important role in the biological control of rice stem borers (lepidopterans) because its eggs "serve as an alternate host of *Trichogramma* spp., egg parasites of rice stem borers, when the egg masses of the borers are not available in the fields" (Yano, 1975). Chandavimol et al. (1975) have published on the biology of *Sepedon spangleri* O. Beaver.

The Oriental Sciomyzidae are in great need of taxonomic revision; there are at least two endemic genera and seven species that have not been described (Knutson, in preparation). With 26 described species in six genera, the Oriental sciomyzid fauna is apparently smaller than that of any other region. *Sepedon*, with 11 species, and *Pherbellia*, with six species, are the dominant genera. Several Oriental species of *Sepedon* belong to the subgenus *Parasepedon*, a large and distinctive group known elsewhere only from the Ethiopian Region. The relationships of the Oriental and Ethiopian *Sepedon* faunas have been indicated by Steyskal and Knutson (1975), based on studies of derived characters of adults.

This paper deals with five species of *Sepedon* (*S. ferruginosa* Wiedemann, *S. plumbella*, *S. senex* Wiedemann, *S. spangleri*, and *S. aenescens* (= *S. spegea* (Fabricius) in part, and *S. sauteri* and *S. violacea*). A visit by Berg to Thailand and Indonesia in 1970 to study problems of interest to the Office of Environmental Sciences, Smithsonian Institution, provided the opportunity to collect Sciomyzidae native to those countries. Living adults of *S. plumbella* and *S. senex*, both collected in Thailand and Indonesia, were transported successfully to Washington, D.C. and were reared through complete life cycles. Subsequently, Beaver studied all five species at Chiang Mai University, Thailand during 1971-1974.

Adults of all five species were found in marshy areas and around ponds near rice fields. The marshes are flooded, with maximum water depths of about $\frac{1}{3}$ to 1 m, during the rainy season. During the rest of the year, usually November through June, their soil is exposed. Water-tolerant grasses and sedges and other, more aquatic, plants grow throughout these marshy areas. The ponds differ in being covered with water throughout the year, with average maximum depths of 1 to 2 m during the rainy season and $\frac{1}{3}$ to 1 m during the dry season. Whether located in marshy areas or not, most ponds are surrounded by hygrophilous vegetation, including many of the plant species also found in marshes. In the permanently inundated areas, there is a zonation and progression from this typical marsh flora to such truly aquatic spermatophytes as *Jussiaea repens* L., *Pistia stratiotes*

Table 1. The range and mean $\pm$ S.D. of incubation period, the larval instar periods, the puparial period, and the preoviposition period of the species studied.

Sciomyzids	Incubation period (days)		First larval stadium (days)		Second larval stadium (days)	
	R	M $\pm$ S.D.	R	M $\pm$ S.D.	R	M $\pm$ S.D.
<i>S. ferruginosa</i>	1-6	3.16 $\pm$ 0.73	2-8	3.74 $\pm$ 1.45	2-8	3.78 $\pm$ 1.38
<i>S. plumbella</i>	1-5	2.86 $\pm$ 0.66	2-7	3.38 $\pm$ 0.79	2-6	3.48 $\pm$ 0.70
<i>S. senex</i>	1-7	3.09 $\pm$ 0.79	4-5	4.38 $\pm$ 0.48	3-5	3.83 $\pm$ 0.69
<i>S. spangleri</i>	1-10	3.38 $\pm$ 1.20	2-11	4.89 $\pm$ 1.46	2-9	3.84 $\pm$ 1.35
<i>S. spangleri</i> ¹	3-4	3.55 $\pm$ 0.51	4-5	4.35 $\pm$ 0.49	2-4	2.95 $\pm$ 0.76
<i>S. aenescens</i>	1-6	2.65 $\pm$ 0.93	2-5	3.03 $\pm$ 0.78	2-5	3.48 $\pm$ 0.78
	Third larval stadium (days)		Puparial period ² (days)		Preoviposition period (days)	
	R	M $\pm$ S.D.	R	M $\pm$ S.D.	R	M $\pm$ S.D.
<i>S. ferruginosa</i>	2-10	4.90 $\pm$ 1.58	5-22	7.21 $\pm$ 1.61	2-22	13.84 $\pm$ 6.10
<i>S. plumbella</i>	3-9	4.66 $\pm$ 1.14	5-14	7.27 $\pm$ 1.94	5-20	8.54 $\pm$ 3.97
<i>S. senex</i>	3-4	3.40 $\pm$ 0.49	3-6	5.00 $\pm$ 1.00	3-18	10.75 $\pm$ 5.34
<i>S. spangleri</i>	3-12	6.08 $\pm$ 2.38	5-17	8.06 $\pm$ 3.38	2-10	4.70 $\pm$ 1.78
<i>S. spangleri</i> ¹	3-5	4.45 $\pm$ 0.61	8	8.00 $\pm$ 0.00	3-5	4.60 $\pm$ 0.86
<i>S. aenescens</i>	2-5	3.46 $\pm$ 0.72	3-8	5.31 $\pm$ 1.04	7-23	14.50 $\pm$ 5.68

¹ Data of Chandavimol et al., 1975.² Period from puparium formation to emergence of adult.

L., *Lemna polyrhiza* L., *L. paucicostata* Hegelm., *Scirpus grossus* L., *Monochoria hastata* Solms., *Typha angustifolia* L., *T. elephantina* Roxb., and *Ipomoea aquatica* Forsk.

Except for minor differences noted below, the methods described by Neff and Berg (1966) for collecting and rearing species of *Sepedon* were employed in this study. Wooden applicator sticks about 2 mm in diameter were used as resting and oviposition sites in the breeding jars. These are readily available in pharmacies and medical dispensaries, and they remain rigid even when wet. Absorbent cotton or "cotton wool" was used in place of sphagnum moss to provide a moisture-retaining substrate in the breeding jars. The eggs laid each day were transferred to closed, plastic petri dishes containing 5 mm of water. The technique used for shipping live flies great distances was described by Kaczynski et al. (1969).

The ranges, means, and standard deviations of the incubation period, three larval stadia, puparial period (period from puparium formation to emergence of adult), and preoviposition period for all five species included are given in Table 1. Information is given on the biology and life cycles of all species.

Sepedon ferruginosa Wiedemann

Sepedon ferruginosa has been collected from widely dispersed localities ranging from western Pakistan, through continental southeast Asia, to Taiwan and the Philippines (Luzon) (Fig. 1). Nothing has been published on the biology of this species. Yano (1968) noted that it, "... seems to be more abundant than *plumbella* or *senex* in the paddy fields."

Adult flies have been collected during all months except April. In seasonally wet marshes in Thailand, adults are most abundant shortly after the beginning of the rainy season.

Our rearings were started from eggs laid by flies caught at Chiang Mai and Bangkok, Thailand during July, August, and September, 1971 and during 1972.

Adult longevity in the laboratory was 30 to 177 days. Flies mated readily, and eggs were laid in rows, disordered clumps, or singly on leaves or stems of aquatic plants, on the side of the rearing jars, or on the gauze stretched across the openings of the jars. Newly laid eggs are white, but the chorion becomes straw colored after a few hours. Wild-caught females that were placed in breeding jars in the laboratory usually started to lay eggs on the day they were caught. Each female oviposited daily, with interruptions of only a day or two at irregular intervals. In one exceptional case, a female did not oviposit for 12 days, then resumed egg production. Most females oviposited until the day before they were found dead.

The oviposition period in the laboratory ranged from 1 to 40 days but was usually between 10 and 30 days. Individual females produced from 6 to 790 eggs after being captured and confined. The maximum number (790) of eggs laid by any individual female was produced over a period of 23 days. Only 339 eggs were laid by the female with the longest observed oviposition period (40 days).

The larvae are aquatic predators. Newly hatched larvae are white and about 1 mm long. They swim actively and attack snail prey readily. They survived for 24 hours without food and still attacked effectively when they encountered suitable food snails.

The larvae were usually fed on snails found in the habitats of sciomyzid flies. Included were four pulmonate species, *Indoplanorbis exustus* Deshayes, *Lymnaea (Radix) auricularia swinhoei* H. Adam, *Gyraulus bakeri* Brandt, and *G. convexiusculus* Hutton and three operculate species, *Idiopoma filosa* (Reeve), *Hydrobiodes nassa* (Theobald), and *Idiopoma ingallsiana* (Lea). Larvae of all instars attacked and killed pulmonate snails of suitable sizes. First-instar larvae only 1 mm long frequently were able to kill snails (*Indoplanorbis exustus*) 3 mm in diameter. Larger snails often were killed when they were attacked by more than one larva simultaneously.

Although the larvae probably cannot kill operculate snails, they fed on them when these snails were crushed. When the snail supply was limited, larvae were reared from hatching to pupation on snails of the three operculate species listed above. The death rate of newly hatched larvae appeared to be less if they were fed crushed snails, even when the alternative was living, pulmonate snails of suitable sizes. Large, third-instar larvae can attack larger snails, and they also have a higher overall ratio of successful attacks than the younger, smaller larvae.

Third-instar larvae and pupae were found in marshes during October. Some pupae were parasitized by *Eupteromalus* sp. (Chalcididae). Six to 15 parasites were reared from each parasitized pupa.

Sepedon plumbella Wiedemann

Sepedon javanensis Robineau-Desvoidy, 1830

Sepedon javana Macquart, 1843

Sepedon fuscinervis Brunetti, 1907

Sepedon sanguinipes Brunetti, 1907

Sepedon plumbella and another species treated herein, *S. senex*, are common species which are frequently found together and are very similar morphologically. Any study of the biology or ecology of Sciomyzidae involving the two species will require a reliable and preferably simple method of separating them. Yano (1968) described several useful diagnostic characters: Males of both species have distinctive surstyli; in males of *S. senex* the basal segment of the fore tarsus is simple, whereas this segment in males of *S. plumbella* is broadened and has a characteristic diagonal groove dorsally; females of *S. plumbella* have the second segment of the fore tarsus shorter than half the length of the first segment, whereas this segment is equal to or longer than half the length of this segment in *S. senex*; the hind tibia of *S. plumbella* has no distinct dark patch, whereas that of *S. senex* has a basal and an apical dark patch. We have found additional characters of both males and females that are very reliable. Abdominal segments 1 plus 2 are strongly constricted laterally at the basal third in *S. senex* and these terga are transversely rugulose dorsally, whereas in *S. plumbella* these segments are not constricted and they are smooth.

As might be expected of a broadly distributed species such as *S. plumbella*, adults show considerable morphological variation. The infuscation of the wing is particularly variable, ranging from entirely dark brown (central and southern parts of the range) to hyaline with the infuscation at the apex of the wing blending with the infuscation around the posterior crossvein and usually extending along the third vein to the anterior crossvein (northern parts of the range). In *S. senex*, the infuscation at the wing

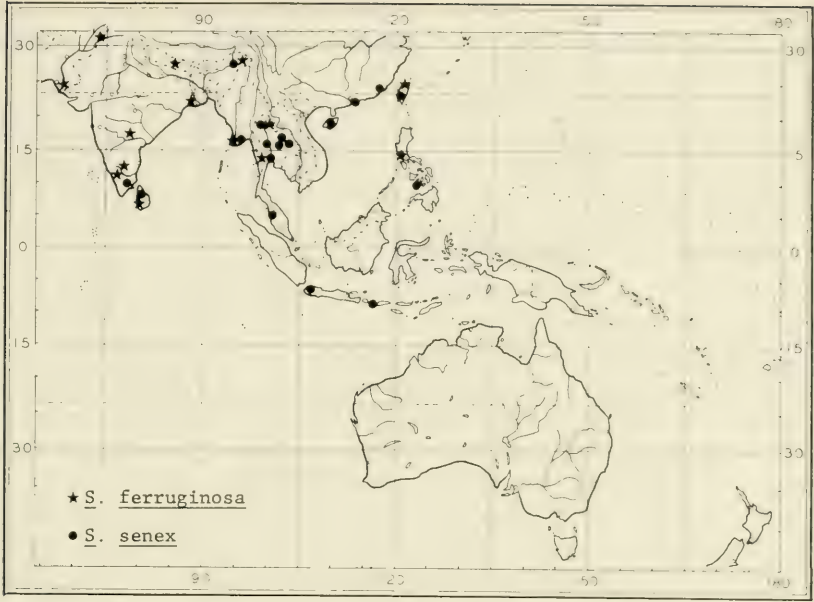


Fig. 1. Distribution of *Sepedon ferruginosa* and *S. senex*.

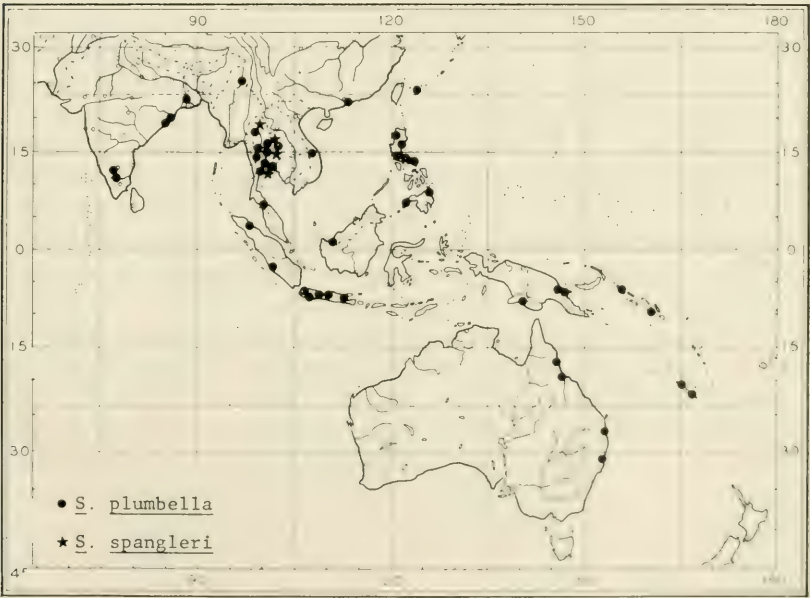


Fig. 2. Distribution of *Sepedon plumbella* and *S. spangleri*.

apex is sharply delimited and does not reach the posterior crossvein; both crossveins are discretely infuscated; and the third vein is not infuscated between the crossveins.

Sepedon plumbella is the most widespread species of Sciomyzidae on the coastal plains of southeast Asia and on the islands lying to the south and east (Fig. 2). In many breeding sites in the Oriental and Australian regions it is also the most abundant species. Although known to occur at elevations of about 1,700 m, this species is far more typical of the lowlands. Adults have been collected in all months of the year.

The distribution patterns of *S. plumbella* and *S. senex* suggest that the former is better adapted to lowland environments. Competitive advantages in the physical environment and amidst the characteristic biota of the tropical lowlands may explain the dominance of *S. plumbella* on the coastal plain of southeast Asia and its spread through Pacific islands eastward and southward to New Caledonia and eastern Australia. However, *S. senex* is more common at Khon Kaen (150 m) and Chiang Mai (300 m), Thailand, and may be better adapted to the conditions there. Both areas are isolated from the low, flat coastal plain by ranges of hills, and the environmental conditions of both are substantially different from those of the coastal plain.

We reared *S. plumbella* from adults collected near Jakarta and Bogor, Indonesia, during late November 1970, and from adults collected in Kalasin, Maha Sarakham, Udorn, and Chiang Mai, Thailand during 1971 and 1972. In Thailand, adults, larvae and pupae were found in marshes and ponds similar to the habitats where other species of *Sepedon* were studied. In Indonesia, adults were collected in a paddy field on the northern coastal plain, 29 km west of Jakarta, that was completely exposed to direct sunlight. The field had been planted in rice in previous years but was then lying fallow. It was covered by water that varied from a few centimeters to $\frac{1}{2}$ meter in depth, and a dense growth of water-tolerant grasses and herbaceous vegetation emerged through the shallow water. Snails of the species *Lymnaea* (*Radix*) *auricularia rubiginosa* (Michelin) were quite numerous there, and *Sepedon senex* adults were associated with *S. plumbella*. The second collecting site in Indonesia was the wet, muddy margin of a small stream draining rice paddies in mountain foothills (elevation 250 m) 6 km northwest of Bogor. It was limited to an area only 3 meters wide and 20 meters long which supported a dense growth of water-tolerant grasses. Twenty-seven *S. plumbella*, but no other Sciomyzidae, were found at this site. Snails collected there included *Lymnaea* (*R.*) *a. rubiginosa* (the dominant species), *Melanoides tuberculata* (Müller), and *Bithynia truncatum* (Eyd. and Soul.).

Both reared and wild-caught adults mated readily in laboratory breeding

jars. In the laboratory, females usually laid eggs singly, in clumps, or in rows of a few eggs. The newly laid eggs were straw colored, but they gradually changed to light grey about 5–10 minutes later. The flies laid eggs nearly every day, with an occasional interruption of a few days, until 1 to 7 days before they died. A female that lived for 31 days after emerging in the laboratory laid 126 eggs and was found dead only a day after she had stopped ovipositing. She started to lay eggs 20 days after emerging, which was the longest preoviposition period observed for *Sepedon plumbella*. The greatest longevity of adults in the laboratory was about 2½ months.

Larvae of *S. plumbella* live equally well on a moist substrate or in standing water and qualify in all other respects as predatory, aquatic, tetanocerine larvae. They attacked and quickly killed pulmonate snails of all genera exposed to them during rearings in Washington, D.C.: *Biomphalaria* Preston, *Gyraulus* Agassiz, *Helisoma* Swainson, *Lymnaea* Lamarck, and *Physa* Draparnaud. During rearings in Thailand, larvae at various stages of development attacked and killed all non-operculate snails of the suitable sizes provided (*Indoplanorbis exustus*, *Lymnaea* (*Radix*) *auricularia swinhoei*, *Gyraulus bakeri*, and *G. convexiusculus*), but they did not kill operculate snails. First- and second-instar larvae fed on freshly crushed pulmonate and operculate snails when there was a shortage of pulmonate snails small enough for the larvae to kill. Experimental exposure of *Lymnaea* (*Radix*) *viridis* (Quoy and Gaimard) (= *L. ollula* Gould) to larvae of *Sepedon plumbella* has shown that that species, the snail host of the giant liver fluke of cattle in Hawaii, also is vulnerable to attacks by these larvae.

Third-instar larvae collected from the field were usually larger than the largest larvae reared in the laboratory in Thailand, suggesting that the laboratory conditions were not optimum. Larvae remained in each snail shell long enough to satisfy their immediate hunger, usually at least an hour and sometimes 2 or 3 hours. However, they always killed another snail rather than returning to the remains of the previous victim, and some larvae killed more than a dozen snails to attain their full larval growth. They killed snails in the water as well as on land, maintaining their floating positions even while supporting the weight of snails considerably heavier than themselves. Flotation is accomplished by buoyancy from the bubble of air always held in the gut and the hydrofuge properties of the hairs surrounding the posterior spiracular slits, making them resist being pulled down through the surface film (Berg, 1964).

Bhuangprakone and Areekul (1973) reported that larvae developed at different rates when fed on different snail species (*G. convexiusculus* and *I. exustus*) but reared at a constant temperature ($25 \pm 1^\circ\text{C}$). They also found that newly hatched larvae will feed on eggs of *L. (R.) a. rubiginosa* and *I. exustus*.

Sepedon senex Wiedemann

Characters for recognition of *Sepedon senex* are presented under *S. plumbella*, above. Literature references to *S. senex* deal solely with capture data, external morphology, and distinguishing characters; nothing has been published on the biology of this species.

On the mainland of southeast Asia, *S. senex* has been collected in all countries in which *S. plumbella* has been reported except Laos. However, its range in the islands southeast of Asia is far less extensive and confined to the west of Weber's line (Fig. 1).

As other species of *Sepedon*, *S. senex* has been collected in all months of the year, but adults became rare during January in Chiang Mai.

Our rearings of *S. senex* were started with adults collected from the grassy margin of a shallow pond, fully exposed to sunlight, near Ban Keng, about 24 km east of Khon Kaen, Thailand on November 14, 1970, and with adults collected at Khon Kaen and Chiang Mai during 1971 and 1972.

Field-collected adults mated readily. The preoviposition period of most of the females bred in the laboratory ranged from 5 to 12 days. Females placed eggs in the same manner as *S. plumbella*, but their eggs became dark grey 5 to 10 minutes after being laid. By laying eggs daily for most of the oviposition period, most females laid 100 to 200 eggs in the laboratory. The maximum number (452) of eggs laid was produced by a wild-caught female that lived 36 days and had the longest oviposition period (34 days) observed for this species. The greatest longevity observed for *S. senex* was 45 days, but this female stopped laying eggs 22 days before she died.

The larvae of all instars attacked and killed pulmonate snails of all species provided during rearings in Thailand. Larvae reared in Washington, D.C. killed and consumed *Helisoma trivolvis* (Say) and *Physa* sp. Newly hatched larvae survived about 24 hours without food.

Indoplanorbis exustus very probably is the natural food snail of *Sepedon senex* larvae, at least in the pond near Ban Keng where breeding stock of *senex* was obtained. All other snails collected there, *Bithynia siamensis* (Lea) and *Idiopoma ingallsiana* (both abundant) and *I. bengalensis* (Lamarck), *Pila polita* (Deshayes) and *P. gracilis* (Lea) (less common), are operculate. Although larvae of *senex* fed as readily as other larvae on freshly crushed operculate, it is unlikely that they can kill and feed on operculate snails in nature.

Sepedon spangleri O. Beaver

This recently described species is known only from Bangkok, Maha Sarakham, Khon Kaen, and Chiang Mai, Thailand (Fig. 2). Adults have been collected throughout the year at seven sites just north of the Lam-

pang-Chiang Mai Highway between km 85 and km 93. The species has been reared recently by Chandavimol et al. (1975).

Wild-caught adults lived up to 30 days after being captured and confined. Females laid eggs singly or in clumps on leaves, on the sides of the jars, and on the gauze coverings. Most of the females began laying eggs on the day they were caught or the day after, but two of them delayed oviposition until 11 days after they were caught. The longest oviposition period was 18 days, and that female produced 106 eggs. The greatest number of eggs laid by any individual in the laboratory, 116, was produced in 5 days by a female that survived only 6 days after she was caught and confined.

The developmental periods given in Table 1 agree closely with those obtained by Chandavimol et al. (1975). The latter authors kept adults alive in the laboratory from 84 to 267 days (mean, 193.3), and the 10 females that they reared produced from 213 to 613 eggs (mean, 414.7).

The larvae are aquatic predators, and they were able to kill pulmonate snails of suitable sizes during all larval stadia. However, young first-instar larvae were not as active swimmers as young larvae of the other species of *Sepedon* studied. Also, the mortality of newly hatched larvae was high in comparison with that of the 4 other species.

Sepedon aenescens Wiedemann

S. imbuta Wiedemann, 1830

S. violacea Hendel, 1909

S. sauteri Hendel, 1911

S. sinensis Mayer, 1953

Various authors have considered the common *Sepedon sphegea* (Fabricius) as ranging from western Europe throughout Eurasia and much of the Oriental region. Other authors have applied the above names to Oriental specimens that differ from typical *S. sphegea* primarily in color characters. Rozkošný (1969) recognized *S. sphegea* and *S. aenescens* from eastern Afghanistan on the basis of male genitalic characters. Recent study of specimens from throughout the distribution of this complex has revealed new characters of the male postabdomen that show that only two species are involved (Orth, et al., in preparation). *Sepedon sphegea* extends from Europe eastward to Afghanistan and northwestern India and northeastward to Mongolia and northeastern Siberia. *Sepedon aenescens* occurs southeast of this area, extending to southern India, Thailand, and the northern Philippine Islands.

The biology of *S. sphegea* has been discussed by Neff and Berg (1966). Nagatomi and Kushigemachi (1965) and ChannaBasavanna and Yano (1969) have written on the biology of *S. aenescens* (as *S. sauteri*).

In this study, *S. aenescens* was reared from adults collected around swamps and ponds in Udorn, Karasin, Khonkan, and Chiang Mai, Thailand, during 1971 and 1972. The flight period at Chiang Mai was from June to November in 1971 and from the middle of July to December in 1972. A few adults were collected at Chiang Mai in April 1974, and from other localities in May 1971. Adults have been collected during all months of the year in various parts of the geographical range of the species.

Adults mated readily and frequently in the laboratory, within 1 to 7 days after they were captured. Eggs were laid in rows on leaves included in the rearing jars, on the walls of the jars and on the cloth covers.

The larvae are active aquatic predators; they tolerated water fouled by dead snails better than larvae of the other species of *Sepedon* included in this study. Larvae of all three stadia attacked and killed all non-operculate snails exposed to them. More than one larva often attacked the same snail. Third-instar larvae were able to kill snails quicker than were first- and second-instar larvae. Further life cycle details are shown in Table 1.

Six to 15 parasitic wasps (*Eupteromalus* sp., Pteromalidae) were reared from each of several puparia of *S. aenescens*.

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A KEY AND SELECTED NOTES FOR THE IDENTIFICATION
OF LARVAE OF SEPSIDAE (DIPTERA) FROM THE
TEMPERATE REGIONS OF NORTH AMERICA

Robert L. Mangan

Abstract.—Distribution notes, habitat notes and a key to species are provided for the nine species of Sepsidae making up 99% of the specimens collected in Virginia, Ohio and Indiana. Most of these species are Holarctic. All known larvae of Sepsidae are scavengers and feed on carrion, sewage, feces, and perhaps rotting vegetation.

The family Sepsidae is represented in North America by 26 species in nine genera. Most of the common species are Holarctic and were described from European material. Most of the descriptive work concerning the immatures of European species was done by Hennig (1949) and Schumann (1962). Papers by Mohr (1943) working in Illinois and Laurence (1954) in England include most of the previous work concerning the ecology of the immature Sepsidae. This study was made from specimens from rearings in Virginia, Ohio, and Indiana during the summer months of 1968, 1969, and 1971. The species included in this key represent more than 99% of all specimens of Sepsidae collected during these months.

Known Distribution of Species in Key

- Meroplus stercorarius* (Robineau-Desvoidy) 1830. Europe, British Columbia, Quebec, Virginia west to Utah.
- Nemopoda nitidula* (Fallén) 1820. Europe, Alberta, Quebec south to Virginia, Ohio, Indiana.
- Saltella sphondylii* (Schrank) 1803. Europe, Virginia to California, Quebec.
- Sepsis biflexuosa* Strobl 1893. Europe, British Columbia to Quebec, Virginia to New Mexico, Illinois.
- Sepsis neocynipsea* Melander and Spuler 1917. All U.S.A., Alaska to Quebec, Mexico south to Mexico City.
- Sepsis punctum* (Fabricius) 1794. Europe, all eastern U.S.A., California, Texas.
- Themira putris* (L.) 1758. Scandinavia, Europe, British Columbia to Quebec, Virginia to California.
- Enicita annulipes* (Meigen) 1826. Europe, Quebec to Virginia, Ohio west to Montana.
- Enicomira minor* (Haliday) 1833. Europe, Virginia west to Idaho, Michigan, New York.

The following community types have been intensively sampled and indicate likely larval habitats.

Feces in open pastures: *Sepsis punctum*, *S. neocynipsea*, *S. biflexuosa*, *Saltella sphondylii*.

Cattle feeding pens (wet soil, masses of feces): *Sepsis punctum*, *S. biflexuosa*, *Meroplius stercorarius*, *Themira putris*, *Enicita annulipes*, *Enicomira minor*.

Small mammal feces: *Sepsis punctum*, *S. neocynipsea*, *Nemopoda nitidula*.

Sewage leaks and overflows: *Enicita annulipes*, *Sepsis biflexuosa*.

Small mammal and fish carrion: *Meroplius stercorarius*, *Nemopoda nitidula*, *Sepsis punctum*, *S. neocynipsea*.

Rotting vegetation in mesic woodlands: *Themira putris*, *Sepsis punctum*, *Meroplius stercorarius*, *Nemopoda nitidula*.

Family Characteristics, Third-Instar Immatures

Segment 1 with dorsal sensory papillae and ventral sensory plate present. Facial mask with rami surrounding atrium, various degrees of facial sculpturing. Cephalopharyngeal skeleton: Complete, dorsal bridge with windows, mouth hooks paired, pharyngeal floor extending beneath hypostomal sclerite. Anterior spiracles with pinnately arranged papillae, 1 or 2 terminal papillae present. Ventral surface with creeping welts and 2 rows of sclerotized spinules. Terminal segment with dorsal projections on posterior spiracular process and ventral projections on (or anterior to) posterior spiracular process.

Key to Third Instars of Sepsidae

1. Anterior spiracles extending laterally from body, greater than 10 papillae per spiracle (Fig. 1, 2) 2
 - Anterior spiracles appressed to body, directed anteriorly, fewer than 9 papillae per spiracle (Fig. 3) 6
2. Posterior spiracles directed posteriorly from sagittal midline, parastomal bar (p.b.) extending less than $\frac{1}{4}$ length of hypostomal sclerite (h.s.) (Fig. 4) Enicita annulipes (Meigen)
 - Posterior spiracles directed dorsoposteriorly from dorsoposterior surface, parastomal bar at least extending $\frac{1}{4}$ the length of hypostomal sclerite 3
3. Posterior spiracles arising independently from posterior surface of terminal segment, segment truncate, not tapering (Fig. 5) Enicomira minor (Haliday)
 - Posterior spiracles may be fused at base, posterior segment tapering posteriorly from anal pad to dorsoposterior spiracular processes 4

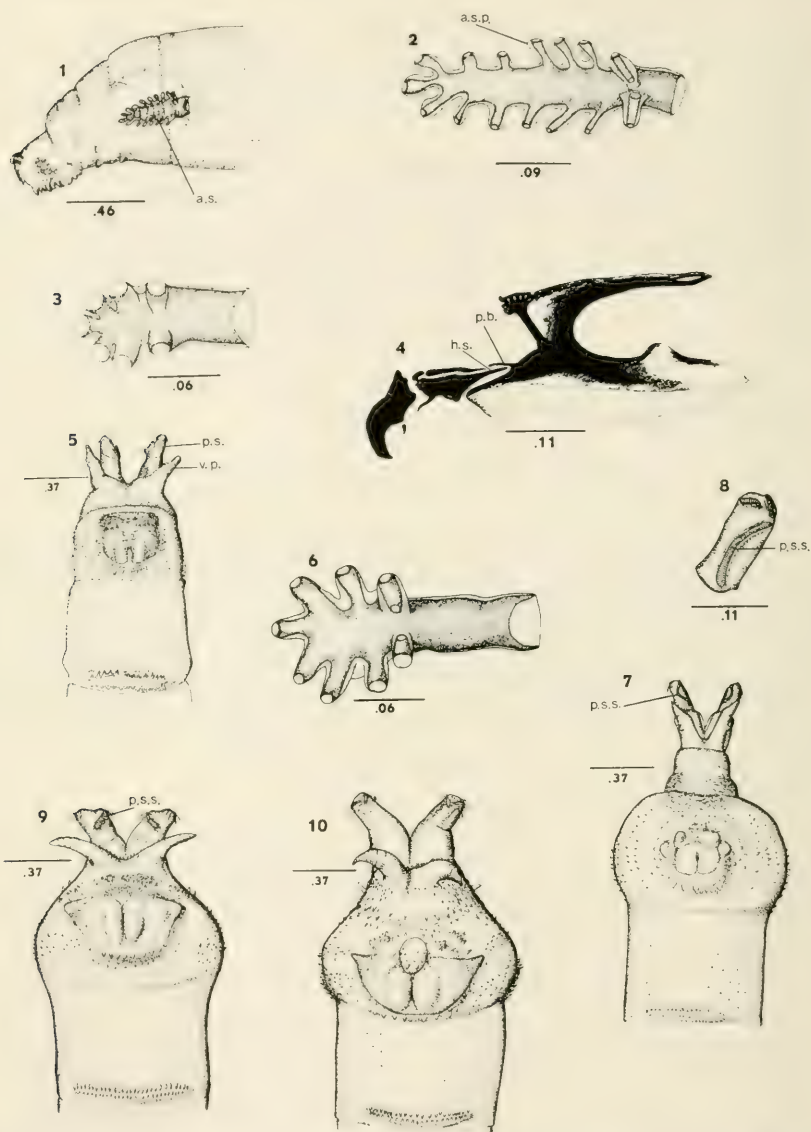


Fig. 1. Anterior segments, *T. putris*. Fig. 2. Anterior spiracle, *T. putris*. Fig. 3. Anterior spiracle, *S. punctum*. Fig. 4. Cephalopharyngeal skeleton, *E. annulipes*. Fig. 5. Posterior segments, ventral view, *M. stercorarius*. Fig. 6. Anterior spiracle, *M. stercorarius*. Fig. 7. Posterior segments, ventral view, *S. biflexuosa*. Fig. 8. Posterior spiracle, median view, *S. biflexuosa*. Fig. 9. Posterior segments, ventral view, *S. neocynipsea*. Fig. 10. Posterior segments, ventral view, *S. punctum*.

Abbreviations are: a.s., anterior spiracle; a.s.p., anterior spiracle papilla; h.s., hypostomal sclerite; p.b., parastomal bar; p.s., posterior spiracle; p.s.s., posterior spiracular slit; and v.p., ventral process.

4. Basal papillae of anterior spiracle at least $2\times$ as long as terminal papillae, terminal segment with tapering part drawn out to length longer than bulbous part of segment, ventral process on posterior spiracle forked
Saltella sphondylii (Schrank)
- Anterior spiracle papillae of nearly equal size, terminal segment tapering but not elongated (Fig. 2), ventral process not forked 5
5. Anterior spiracle greatly elongated, usually more than 15 papillae, spiracle length at least $9\times$ as long as longest papilla
Themira putris (L.)
- Anterior spiracle shortened, not more than 14 papillae, spiracle length at most $5\times$ as long as longest papillae
Nemopoda nitidula (Fallén)
6. Terminal abdominal segment nearly identical in lateral width to 11th segment, lateral surface of 1st segment bare, anterior spiracles with 8 papillae (Fig. 5, 6)
Meroplius stercorarius (Robineau-Desvoidy)
- Terminal abdominal segment often larger in lateral width than 11th segment, lateral surface of 1st segment with rami connecting to ventral surface, anterior spiracles with 6 or 7 papillae 7
7. Posterior spiracles joined at base of sclerotized part (Fig. 7), ventral processes attached at base of sclerotized part, spiracular slit (Fig. 8) extending the length of the sclerotized part of spiracle, tapering part of terminal segment longer than bulbous part
Sepsis biflexuosa Strobl
- Posterior spiracles not joined at base of sclerotized part, ventral process arising from base of fleshy part of spiracular process, spiracular slits either terminal or encircling sclerotized part of spiracle, tapering part of terminal segment shorter than bulbous part 8
8. Posterior spiracle with 1 slit on medioventral surface of sclerotized part (Fig. 9)
Sepsis neocynipsea Melander and Spuler
- Posterior spiracle with all slits on terminal surface (Fig. 10)
Sepsis punctum (Fabricius)

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OBSERVATIONS ON THE VARIABLE OAK LEAF CATERPILLAR,
HETEROCAMPA MANTEO (DOUBLEDAY)
(LEPIDOPTERA: NOTODONTIDAE) IN MARYLAND

Charles L. Staines, Jr.

Abstract.—Observations were made on a *Heterocampa manteo* (Doubleday) population in Frederick County, Maryland. These observations included: An overwintering larval survey, a blacklight trap for adult monitoring, and visual damage surveys.

In 1973, 16 square miles of the Frederick Municipal Forest, Frederick County, Maryland were defoliated. This forest is predominantly oaks with scattered areas of maples, beech, birch, and hemlock. The defoliation was primarily due to the variable oakleaf caterpillar, *Heterocampa manteo* (Doubleday) although larvae of the following species were collected: the orangestriped oakworm, *Anisota senatoria* (J. E. Smith); the saddled prominent, *Heterocampa guttivitta* (Walker); the greenstriped mapleworm, *Dryocampa* (= *Anisota*) *rubicunda* (F.); and the luna moth, *Actias luna* (L.)

By September 1973 the population appeared to be on the verge of collapse due to a nuclear polyhedrosis virus and a fungus disease (probably *Cordyceps* sp.). These two diseases combined to kill 60% of the larvae still in the trees.

In January 1974, Morris Hewitt, a Frederick County resident, found a large number of larvae in the leaf litter.

On 24 January the first observations on the overwintering larvae were made by the author. Five sites in the defoliated area were selected at random and two one-square foot samples of forest litter (approximately 5 inches deep) were collected from each site. The number of larvae and depth of forest litter were noted. The larvae found were collected and maintained in the laboratory at 40°F until early April. They were then held at 65°F until adults or parasites emerged. A blacklight trap was placed in the defoliated area in April to help determine adult emergence. Visual observations were made during the summer to determine the extent of larval feeding damage.

The data collected during the winter of 1974 is summarized in Table 1. The average number of *Heterocampa manteo* larvae per square foot was 4.03. During the winter survey, two birds, the European starling (*Sturnus vulgaris* L.) and the common grackle (*Quiscalus quiscula* (L.)), were seen in large flocks feeding in the litter. Two *Pterostichus* spp. (Coleoptera: Carabidae) were observed feeding on *H. manteo* larvae in the soil.

Table 1. Summary of 1974 overwintering *Heterocampa manteo* larval survey in Frederick County, Maryland.

Date	No. larvae	No. pupae
1/24	97	0
2/14	59	0
3/8	82	0
3/26	98	0
4/18	46	0
4/25	29	0
5/2	39	0
5/9	26	0
5/16	31	0
5/22	22 ^c	1
5/30	36	0
6/6	31	0
6/13	17 ^a	0
6/20	18	0
6/27	40	0
7/3	— ^b	0
7/11	6	3
7/18	— ^b	0
7/26	8	5
	<u>685</u>	<u>9</u>

^a Adults first captured in blacklight trap.^b Survey not conducted.^c Pupae first collected.

Only one parasite emerged from the 685 *Heterocampa manteo* larvae collected. This specimen was identified as *Lespesia stonei* Sabrosky (Diptera: Tachinidae).

Houser (1918) stated that adult emergence of *Heterocampa manteo* begins in late April or early May in the Washington, D.C. area. No pupae were collected until May 22. No adults were collected in Frederick County until June 13. *Heterocampa manteo* was never a dominant species in the blacklight collections.

Larvae of *H. manteo* were not detected feeding during the summer of 1974. The species found feeding at this time were: *Dryocampa rubicunda*; *Anisota senatoria*; *A. virginiensis* (Drury), the pinkstriped oakworm; *Nadata gibbosa* (J. E. Smith); *Bucculatrix ainsliella* Murtfeldt (Lepidoptera: Lyonetiidae); and *Cratencersus* sp. (Hymenoptera: Tenthredinidae).

In this study it appeared that parasites played a minor role in the control of *Heterocampa manteo*. The number of predators also appeared insignificant. The two pathogens had some effect, but they occurred too late in the summer to stop the defoliation. In the Frederick area it seemed that vertebrate predators, mainly birds, were a factor in the decline of the

overwintering larval population. It should be noted that the winter of 1973-1974 was the year of the large roost of starlings and grackles at Graceham, Maryland, about 8 mi to the northeast. It is likely that the birds observed in the forest were from that roost.

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A NEW CRYPTOPIID GENUS, WITH KEY TO THE GENERA
KNOWN TO OCCUR IN NORTH AMERICA
INCLUDING MEXICO
(CHILOPODA: SCOLOPENDROMORPHA: CRYPTOPIIDAE)

R. E. Crabill, Jr.

Abstract.—A new Mexican Cryptopid genus and species, *Ectonocryptops kraepelini*, are presented with a key to all Cryptopid genera known to occur in North America including Mexico.

Of the chilopod orders, the Scolopendromorpha is systematically the best developed and most stable. Thanks to the commendable efforts of Kraepelin (1902) and later Attems (1930), a comprehensive higher categorical system that is at once readily workable and for the most part reflective of phylogeny has gained virtually uncontested wide acceptance. Even the great majority of the genera are well-known and easily identifiable. Since the order, in species a large one, is not characterized by generic plenitude, the discovery of a new genus must be an uncommon event. That the new taxon most closely resembles the bizarre *Newportia*, a remote and unique entity in many ways, lends enhanced significance to it.

Ectonocryptops Crabill, new genus

Ectonocryptops, a new genus, unlike most cryptopid genera but like most of the species of *Newportia*, has a distinctly bipartite tarsus on each of legs 1 through 23. Unlike those of nearly all other known genera, the tibiae and tarsi of *Ectonocryptops* are wholly without spurs. *Newportia* and *Ectonocryptops* are very unlike other genera in a number of ways, perhaps most manifestly in lacking an ultimate pedal pretarsus and in the extraordinary departure of their ultimate second tarsi from the norm.

They may be distinguished from each other most readily as follows. In *Newportia*: (1) Ultimate second tarsus long, thin, sometimes nearly whiplike, divided into numerous tarsomeres or pseudosegments and (2) tibial spurs (or a tibial spur) and a tarsal spur always present on some legs, usually on most. In *Ectonocryptops*: (1) Ultimate second tarsus short, subclavate, entire undivided and (2) tibial and tarsal spurs entirely absent.

Type-species: *Ectonocryptops kraepelini*, new species. Monobasic.

Ectonocryptops kraepelini Crabill, new species

Holotype: ♀, Mexico, State of Colima, 2 mi south of Tonila; August 28, 1965; W. R. Gertsch, leg.; in the collection of The American Museum of Natural History, New York.¹

General: Body length, 11 mm. Color, sordid yellow throughout. *Antennae*. Length slightly longer than $2\times$ the head length. Articles, 17 in number; those more proximal but slightly longer than wide, the more distal ones as long as wide, submoniliform in shape. Setae of 1st 2 distinctly longer and more robust than those of other articles. *Cephalic Plate*. Longer than wide (1.2:1). Sides evenly excurved. With a vague frontal suture. Paramedian sutures wholly absent. Rear margin overhanging first tergite. Ocular areas present but poorly defined. *Clypeus*. Submedial and anterior positions each with a pair of long setae; prelabral position with a straight line of 9 stout setae; clypeus otherwise essentially glabrous. *Labrum*. With a single medial tooth; sidepieces not incised to form lateral teeth. *First Maxillae*. Medial lobes short, not exceeding 2nd article of telopodite; coxosternum medially cleft, lateral sutures absent; telopodites large, extending slightly beyond labral anterior margin. *Second Maxillae*. Coxosternum medially diastemate, not divided. Telopodite long, slightly exceeding anterior head margin; second article distodorsally with a single stout spine; 3rd article distodorsally with a fan of long hyaline filaments; pretarsus unguiform, its ventral edge smooth and undivided, its dorsal edge pectinate. *Prehensors*. Flexed, not exceeding anterior head margin. Mesal armature entirely absent. *Prosternum*. Anterior margin slightly bowed forward, without dental plates or other armature. *Spiracles*. Present on pedal segments 3, 5, 7, 8, 10, 12, 14, 16, 18, 20, 22. *Terga*. First tergum with prominent ring suture; posterior to it with 2 paramedian sulci whose ends converge and meet anterocentrally. Paramedian sulci on 2nd through 22nd terga; vague oblique and lateral sulci present on 2 or 3 through 22. *Sterna*. All exceptionally long; subtriangular, their short bases anterior; endosternites long, projecting beneath succeeding sterna, without demarcating sutures. Without longitudinal or transverse apodemes; each with a shallow, vague, midlongitudinal depression. Sparsely setose. *Legs*. With 23 pairs. All notably long and rather slender. Tarsi 1 through 23 each distinctly bipartite. Pretarsal parungues equal and robust, $\frac{1}{2}$ as long as their claws. Spines and spurs entirely absent. *Ultimate Pedal Segment*. As long as the precedent. Tergum slightly wider than long; rear margin rounded posteriorly; without posterocecal spines. Coxopleuron with about 20 small pores, these restricted to ventral $\frac{2}{3}$ and extending for full length. Ventroposteriorly with a long robust acuminate process, tipped with 1 spine and 2 adjacent setae. Sterna greatest width slightly greater than greatest length; sides slightly convergent, straight; rear margin truncating leg. Prefemur slightly shorter than femur; the former ventrofemur slightly shorter than femur; the former ventromedially with 3 equidistant and equal robust spines; the latter with 2; otherwise both clothed with delicate to stout setae. Tibia the longest article; distinctly inflated.

the distomedial sector expanded to form a prominent non-setose lobe; medial surface densely porous, internally densely glandular. First tarsus bulbous, ventromedially excavate, with a low ventroposterior lobe. Second tarsus subclavate; undivided; without pretarsus of any kind.

Etymology: This species is named in honor of Professor Karl Kraepelin, first great monographer of the Scolopendromorpha and past Director of the Zoological Institute and Zoological Museum of Hamburg.

North American and Mexican Cryptopid Genera

1. With 21 pairs of legs and pedal segments 2
 - With 23 pairs of legs and pedal segments (*Scolopocryptopinae*) 3
2. Anterior margin of prosternum with a pair of elongate, coarsely-toothed plates. Cephalic plate with prominent eyespots in ocellar positions. Ultimate pedal segment conspicuously elongate. Ultimate legs extremely heavy and robust (*Theatopinae*)
 - Theatops* Newport
 - Anterior margin of prosternum without such toothed plates. Cephalic plate without eyespots. Ultimate pedal segment of normal proportions. Ultimate legs only slightly heavier than penults (*Cryptopinae*) 8
3. Seventh pedal segment with a pair of spiracles 6
 - Seventh pedal segment without a pair of spiracles 4
4. Prosternal anterior margin with a pair of low, dark, heavily sclerotized ridges. Trochanteroprefemur mesodistally with a prominent spinous process *Scolopocryptops* Newport²
 - Prosternal anterior margin unadorned, without dark, heavily sclerotized ridges. Trochanteroprefemur without a distomesal spinous process 5
5. Legs 1-21 each without trace of intertarsal division. Sternital transverse sulci usually apparent; submarginal sulci typically pronounced *Kethops* Chamberlin
 - Legs 1-21 each with a division between the 1st and 2nd tarsi. Sternital transverse sulci absent; submarginal sulci absent *Thalkethops* Crabill
6. Second tarsus of ultimate leg divided into many segments or pseudo-segments *Newportia* Gervais
 - Second tarsus of ultimate leg entire, without trace of subdivision 7
7. Second tarsus of ultimate leg with a prominent unguiform pretarsus; tibia neither swollen nor densely glandular; 1st tarsus not bulbous *Dinocryptops* Crabill³
 - Second tarsus of ultimate leg without any pretarsus; tibia swollen and densely glandular; 1st tarsus bulbous *Ectonocryptops*, n. gen.

8. Each coxopleuron with a prominent ventroposterior spinous process *Anethops* Chamberlin
- Each coxopleuron without such a process, its posterior border essentially straight *Cryptops* Leach

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Footnotes

¹ For lending this and many other instructive specimens I should like to thank Dr. J. L. Cooke, former Curator of Arachnida, The American Museum of Natural History.

² Formerly (and in Attems, 1930, p. 257) erroneously given as *Otocryptops*. For a clarification of the correct allocation of this name and of *Dinocryptops*, q.v., see Crabill, 1953, p. 96.

³ Formerly (and in Attems, 1930, p. 255) erroneously given as *Scolopocryptops*. For clarification see Crabill, 1953, p. 96.

THE GRESSITT TRAP FOR COLLECTING
TABANIDAE (DIPTERA)

Patrick H. Thompson and Joseph W. Holmes, Jr.

Abstract.—The Gressitt Trap, a tennis, netlike trap for collecting flying insects, was modified to utilize commercially available containers to retain the catches, to eliminate unnecessary muslin reenforcement and suspensory line, and to test a durable and light fine-mesh polyester marquisette as the netting material. In comparison with catches from one Manitoba Trap 100 yards away, the Gressitt Trap took $3.7\times$ more insects, ten more species (one a state record), five additional locality records, and 100% more males (138 specimens of 8 spp.).

The "second bilateral trap" of Malaise (1937) was a tentlike curtain of netting material which was open on two opposing sides with the sides separated by a baffle of the same material extending the 4 yd length of the trap. For concentration of the catch, the conical roof led upward from the center baffle and opposing walls on each side into a collection container at the top of the trap.

Similar traps of netting material, constructed to collect flying insects, have changed both the size and the basic design of the Malaise Trap. The widely-used modification of Townes (1962) employed a similar, rigid, supportive framework and was slightly smaller in size. Most significantly, this cruciform model was designed for multidirectional use, consisting of two intersecting baffles, perpendicular to one another.

The equally popular trap of Gressitt and Gressitt (1962) is drastically different in size and design than the traps of Malaise or Townes. Here, the basic design is more linear and the trap surface area is much larger. Also, the structure does not depend upon a supportive framework but is designed for suspension from trees by line.

These differences affect not only the aspects of cost and construction but of mode of action and trap performance, and so become important factors in first selecting traps. Therefore, the name of the most similar design should be preferred to the common and confusing use of the term Malaise Trap, which is often applied to any of these particular modifications.

Material and Methods

The Gressitt Trap (GT) used in this study was one modified by Dr. Howard V. Weems, Jr., Bureau of Entomology, Gainesville, Florida, who intends to publish plans of the trap. The Gressitts (1962) described three trap modifications, the first of which (Trap A) was that modified by Dr. Weems and again by myself. This trap was not figured by the Gressitts

and some dimensions were not given. We measured a trap loaned to us by Dr. Weems whose modifications did not change design but incorporated suggestions by Townes (1962) for improving the GT (i.e., increasing the slope of the collection containers, using clearer netting, reducing the opacity caused by doubling of netting near the collection containers, and reducing the size of the center panel). It was again modified to simplify, to use available materials, and to speed construction. All muslin reinforcement was omitted except to support grommets at the corners. Plastic collection containers from modified Manitoba Traps (Thompson, 1969) were supported with eye bolts inserted through the centers of the container bottoms. The trap itself was supported by these containers instead of by a heavy line extending beneath the gable, as in previous trap models. A 1 in band of rubber tire tube (motor bike 450-18) was placed over the gap between the lid and the wall of the inverted collection container to exclude rainwater. The trap netting used was 100% polyester black marquisette¹ ("Kismet," Carole Fabrics, 2111 Highland Ave., Augusta, Georgia 30904).

The Study Area

Two Gressitt Traps were operated near College Station, Texas, from April through September, 1975. One GT was erected near the senior author's home on Mile Drive, College Station, Texas, across the channel of an intermittent stream feeding a nearby impoundment. The site was located approximately 100 yards from the house in a post oak forest. One modified Manitoba Trap (MT) was operated in an opening of the senior author's lawn to provide a comparative sample of collection data. Collections from both traps were removed daily and both traps were serviced simultaneously with dry ice placed there for CO₂ production. Fifty-pound blocks of dry ice were retained beneath the traps in styrofoam chests manufactured for that purpose (#35742-009, O.D. 16 in × 16 in × 15½ in, VWR Scientific). The lids were inverted and offset ¼ in to increase gas output.

A second trap was operated in the Navasota River Watershed; the physiography of both sites is described by Thompson (1977). This trap was located in a slough of the Navasota River near its intersection with FM 2038 (Grimes Co.). Detailed information on the tabanid fauna of this area for two consecutive years was described in Thompson (1976). Unless otherwise noted, only the data from the GT at Mile Drive will be considered in this paper because that trap could be serviced daily and it otherwise produced more uniform collection data.

Gressitt Trap Performance

Numbers of Specimens and of Species.—The GT caught 17,370 flies, 3.7× more than the 4,684 specimens taken in 1975 by one MT 100 yards

away; this MT was also operated with CO₂ at this site in 1973 and 1974. The Mile Drive GT produced 26 species of Tabanidae. Only 1 species taken in 2 previous years at this locality with the MT was not taken by the GT in 1975 (*Tabanus stygius* Say, 1♀); conversely, 5 species not taken previously under these circumstances were collected in 1975. One of these (*T. eurycerus* Philip) was a state record. Two other species predominate in south Texas (*T. colombensis* Macquart and *Chrysops virgulatus* Bellardi; 1 female of *C. virgulatus* taken from each of Grimes and Walker Cos.). The 2 species remaining are riverine forms and have been found in large numbers at the Navasota River trap sites 12 mi away (*Tabanus fuscicostatus* Hine and *Hybomitra lasiophthalma* (Macquart)).

Further comparisons of MT performance will concern only the 1975 catches. Ten species in 5 genera were taken in 1975 in the GT that were not taken in the MT that year. But for *Silvius quadrivittatus texanus* Pechuman and *Tabanus eurycerus* which were very rare in the 1975 GT catches (one specimen each), these species were represented by 3–38 specimens (*Chrysops montanus* O.S., *C. virgulatus*, *Leucotabanus annulatus* (Say), *Tabanus cymatophorus* O.S., *T. fuscicostatus*, *T. molestus* Say, and *Hybomitra lasiophthalma*).

Numbers of Male Specimens.—In general, males of Tabanidae do not occur in traps producing large numbers of females. Only 2 male specimens (of *Tabanus subsimilis subsimilis* Bellardi) were taken in MT collections of 3 consecutive years (1973–1975) which totaled 8,275 females of all species. Conversely, the GT produced 138 males for 17,230 females in 1 year. This number included 1–118 males of eight species, nearly one-third of the 26 species collected. Increase in total catch appeared to increase the number of males taken for any given species because (1) the most abundant dominants produced the most males (*T. quaesitus* Stone, *T. s. subsimilis*, and *T. sulcifrons* Macquart) and (2) males were found in 6 of the 8 species represented by over 100 specimens (*Chrysops callidus* O.S., *C. pikei* Whitney, *Tabanus mularis* Stone, *T. quaesitus*, *T. s. subsimilis*, *T. sulcifrons*; *T. proximus* Walker and *T. trimaculatus* Palisot de Beauvois were excepted). However, the latter 2 species were represented in the 1975 GT catches at the Navasota River site; *T. proximus* by 9 males and 1,639 females and *T. trimaculatus* by 2 males and 254 females. As at Mile Drive, the most abundant dominants (*T. fuscicostatus*, *T. proximus*, *T. s. subsimilis*, *T. sulcifrons*, and *Hybomitra lasiophthalma*), produced the most males; and males were found in 8 of the 9 species represented by more than 100 females (*Chrysops pikei*, *Tabanus lineola* L., *T. trimaculatus*, and the 5 species named above; *T. cymatophorus* was excepted).

Male-female ratios in the GT catches reported here suggest that small numbers of males of abundant species can be collected with frequent long-term use of stationary nets. The males of some species have been

extremely rare (e.g., *T. quaesitus*). This experience could only be a function of their small total catch numbers. The incidence of males of other species, such as *T. atratus* F. and *T. s. subsimilis*, will probably continue to be high in all types of collections because of the habits of the males of these species; and the males of still other species, rare, for the same reason.

Physical Trap Features.—The mesh of netting material used (Kismet) was extremely fine, allowing collection of minute Microhymenoptera. The material is run-proof; briars such as *Smilax* would puncture the material but not run it. Kismet is very thin and lightweight and can be greatly compressed for trap portability. The material billows with air movement because it is thin and light but such movement can be restricted by reducing slack with the guy lines. (The trap also billows because the line extending across the gable of previous trap models is absent in this one.) Because the entire weight of our trap was supported by the collection containers, the container lids and bottoms must be securely fastened together when the trap is serviced.

Disposition of Insect Materials.—All insects taken in this study, but for the Hymenoptera taken in the earliest collections (Texas A&M) and for the Tabanidae, were contributed to the Smithsonian Institution, Washington, D.C.

Acknowledgment

I gratefully acknowledge the help of my wife, Connie, for making the traps (PHT).

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Footnote

¹ Mention of a commercial or proprietary product in this paper does not constitute an endorsement by the USDA.

A NEW SPECIES OF THE GENUS *OVERLAETIELLA*
SCHOUTEDEN FROM SUMATRA
(HEMIPTERA: ARADIDAE)

Nicholas A. Kormilev

Abstract.—A new species of an African genus of Aradidae from East Sumatra is described and the name *Overlaetiella orientalis* is proposed.

In 1952, Schouteden established a new genus *Overlaetiella* for two species from Zaïre (Belgian Congo). In 1959, Usinger and Matsuda recognized this genus, added one more species from Cameroons, and noted that *Neuroctenus nitidulus* Bergroth 1887 (= *Neuroctenus rubescens* (Walker, 1873)) from the Oriental Region agrees with *Overlaetiella* in all essential characters. In my monograph "Mezirinae from the Oriental Region and South Pacific" (Kormilev, 1971), I left *rubescens* Walker in *Neuroctenus*, because at that time I could not compare it with African species of *Overlaetiella*. Recently I have had this opportunity, and I concur with Usinger and Matsuda that *rubescens* Walker belongs to *Overlaetiella* Schouteden. Now we have the following synonymy:

Crimia rubescens Walker, 1873, Cat. Hem. Het. Brit. Mus. 7:14.

Neuroctenus nitidulus Bergroth, 1887, Oefv. Finska Vet. Soc. Förh. 29:177.

Neuroctenus rubescens Distant, 1902, Ann. Mag. Nat. Hist. Ser. 7. 9:360.

Overlaetiella nitidula Usinger and Matsuda, 1959, p. 266.

Neuroctenus rubescens Usinger and Matsuda, 1959, p. 273.

Overlaetiella rubescens new combination

Now I have an opportunity to add the second Oriental species of *Overlaetiella* Schouteden, which I propose to name *Overlaetiella orientalis*, new species.

Overlaetiella orientalis Kormilev, new species
(Figs. 1-3)

Female.—Elongate ovate, sparsely granulate; middle and hind femora with row of small, curved spines, and row of sharp granules.

Head as long as its width across eyes (23:23). Anterior process robust, rounded anteriorly, genae granulate and bent downward, contiguous below clypeus, reaching tip of antennal segment I. Antenniferous tubercles short, truncate anteriorly; postocular minute, pointed, reaching outer borders of eyes. Eyes moderately large, semiglobose. Infraocular callosities elongate ovate. Vertex flat, but densely granulate; granules low and smooth. Antennae $1\frac{1}{2}\times$ as long as width of head across eyes (34.5:23);



Fig. 1-3. *Overlaetiella orientalis*, female. 1, head, pronotum and scutellum. 2, tip of abdomen from above. 3, left middle femur from above.

antennal segment I clavate, II and III tapering toward base. IV fusiform; relative length of antennal segments I to VI are 8:7.5:9:10. Labium not reaching hind border of labial groove, which is finely carinate laterally and open posteriorly.

Pronotum less than $\frac{1}{2}$ as long as its maximum width (20:48); fore lobe narrower than hind lobe (37:48). Collar smooth, sinuate. Anterolateral angles rounded, neither produced forward, nor sideways. Lateral borders very finely crenulate, convex at humeri, strongly converging and slightly sinuate anteriorly. Hind border widely sinuate medially. Fore disc slightly depressed medially and with 4 (2+2) flat callosities, surrounded with granulation. Interlobal depression distinct. Hind disc transversely raised medially, elevation surrounded by granulation and flanked postero-laterally by 2 (1+1) transverse callosities, connected medially by smooth carina, extended along hind border. Posterior angles transversely rugose.

Scutellum shorter than its basal width (24:32); all borders carinate, lateral slightly sinuate before apex. Disc with a short, median callosity, extending from basal border to $\frac{1}{3}$ of disc, and flanked by longitudinal, irregular striation; apical $\frac{2}{3}$ of disc with concentric striation.

Hemelytra reaching hind border of tergum VI; corium reaching hind border of connexivum II; its apical angle produced into a point, apical border deeply sinuate. Membrane without veins, white, hyaline at base; brown and with anastomosed veins behind base.

Abdomen ovate, longer than its maximum width across segment IV (85:72); posteroexterior angles of connexiva III to VI slightly protruding, angular; PE-VII rounded. Discs of connexiva separated from midlateral area by distinct black carina. Tergum VII flat, separated from connexiva VII by thin sulci extending from fore border to the middle of disc, more backward there is no clear limit. Tergum VIII narrower than width of head across eyes (20:23). Paratergites rounded, reaching tip of a small, rounded posteriorly segment IX. Spiracles II to VI ventral, placed far from border, VII and VIII lateral and visible from above (in *O. rubrescens* spiracles VII also are lateral, where as in African species spiracles VII are ventral). Venter is flat and smooth, sterna IV to VI with transverse carina along fore border. Genitalia plates densely granulate. Metathoracic scent-gland openings long and narrow, horizontal, placed laterad of middle coxae.

Legs with fore femora with a double row of sharp granules; middle and hind femora with a row of curved teeth and parallel to them with a row of sharp granules. Tibiae with a few sharp granules on upper side.

Color red brown; labium and tarsi yellow.

Total length 6.20 mm; width of pronotum 1.92; width of abdomen 2.88 mm.

Holotype.—♀, (Leiden Museum), East Sumatra, lowland forest; VIII. 1953, A. Sollaart leg.

Overlaetiella orientalis is related to *O. rubrescens* (Walker), 1873, but is smaller and the antennal segment III is only slightly shorter than IV (9:10), where as in *O. rubrescens* it is distinctly shorter (10:15).

In measurements 25 units = 1 mm. Length of abdomen, for convenience, was taken from the tip of scutellum to the tip of segment IX.

Acknowledgments

I am indebted to Dr. Peter H. van Doesburg, Jr., Rijksmuseum van Natuurlijke Historie in Leiden, Netherlands, for the privilege of studying this interesting specimen.

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STUDIES ON IDIOCERINAE LEAFHOPPERS, XVIII: FOUR
NEW GENERA AND SPECIES FROM GUYANA,
SOUTH AMERICA (HOMOPTERA: CICADELLIDAE)

J. Maldonado-Capriles

Abstract.—*Hyalocerus aurantius*, *Luteobalmus maculatus*, *Pseudoidioscopus bipunctatus*, and *Corymbonotus bicolor* are new species in monobasic new genera described from Guyana, South America. Their morphology is discussed and illustrated and they are compared with allied genera and species.

Four new genera are described below from material from Guyana, formerly British Guiana. The specimens were loaned to me for study by Dr. W. L. Knight, from the British Museum (Natural History) where the types are deposited. Paratypes are in my collection (JMC) and in the U.S. National Museum (USNM).

In the descriptions that follow 13 micrometer units are equivalent to 1.0 mm. Throughout the text, in order to save space, I use UFS to mean the upper frontal sutures of the postclypeus (Fig. 28). Following Young (1968) I use r_1 , r_2 , r_3 , and r_4 to respectively identify the upper-inner, upper-outer, lower-outer, and lower-inner row of spines of the metatibia. All the species have the vertex finely shagreen and the metafemur has two apical and no subapical spines.

Hyalocerus Maldonado-Capriles, new genus

Type-species: *Hyalocerus aurantius* Maldonado-Capriles, new species.

Forewing semitransparent, grayish; veins of basal $\frac{1}{2}$ of corium barely visible, concolorous with corium; veins of apical and subapical cells dark. Vertex relatively long, $3\times$ as wide as long (12:4). Pronotum about $2.5\times$ as wide as long (19:7), posterior margin broadly and shallowly concave. Scutellum wider than long (14:11). Face wider across eyes than long (21:18); ocelli apart at $2\times$ distance from ocellus to eye (6:3); UFS curved, reaching about midway to ocellus of corresponding side; lateral margins of postclypeus angled at about midlength; anteclypeus bellshaped, slightly longer than wide apically (5:4). Lora semicircular, not elevated. Gena with margins straight. Forewing with 4 apical, 2 anteapical, and 1 discal cell; inner apical $2\times$ as long as outer and with basal cross vein very tenuous. Spines of metatibia: r_1 and r_3 with 12-14 fine, r_2 with 4-6 strong, and r_4 with 25-30 hairlike spines. Length 4.9 mm.

Male Genitalia.—Valve flattened laterally at apex, long pilosity along apical $\frac{1}{2}$ of upper margin. Pygofer triangular; upper margin membranous,

with a thickened caudal projection on lower margin of membranous area. Aedeagus, slender, its apex slightly curved cephalad; hind margin serrate in lateral aspect; without socle. Connective V-shaped. Style very deep, lower outer apical ledge produced, thumblike and with strong straight apical setae. Valve rectangular, hind margin very slightly concave. Tenth tergum relatively short, each posterior lower angle produced downward into long fine projection (Fig. 6).

Female.—Coloration and shape about as in male. Genitalia with 7th sternum rectangular, posterior margin slightly convex; pygofer $1.5\times$ longer than abdominal sterna together (14:10); ovipositor surpassing pygofer by $2\times$ its width.

Male genitalia separate it from other idiocerine genera with ocelli apart at twice the distance from ocellus to eye. The generic name makes reference to the semitransparent, delicate appearance of the forewings; the ending *cerus*, meaning antenna, is commonly used in naming idiocerine genera. It can be separated from other genera discussed in this paper by the characters in the key.

Hyalocerus aurantius Maldonado-Capriles, new species
(Figs. 1-8)

Male.—Vertex, pronotum, and scutellum orange; with a black longitudinal stripe from behind inner margin of eye extending to about mid-length of scutellum; scutellum apically yellow. Face fading from orange above to yellow at apex. Pleurae and legs yellowish; abdominal sterna with a pinkish tinge; with blackish as follows: Basal inner angle of corium, claval suture, and middle longitudinal vein of corium. Genitalia as in Figs. 1-6. Length 4.9 mm.

Female.—Coloration and shape as in δ . Vertex $3\times$ as wide as long (12:4); pronotum $3.5\times$ as wide as long (21:6.5); scutellum much wider than long; face slightly wider across eyes than long (22:20); post- and anteclypeus as in δ . Ocelli apart at $2\times$ distance from ocellus to eye (6:3). Length 5.1 mm. Genitalia as described for genus.

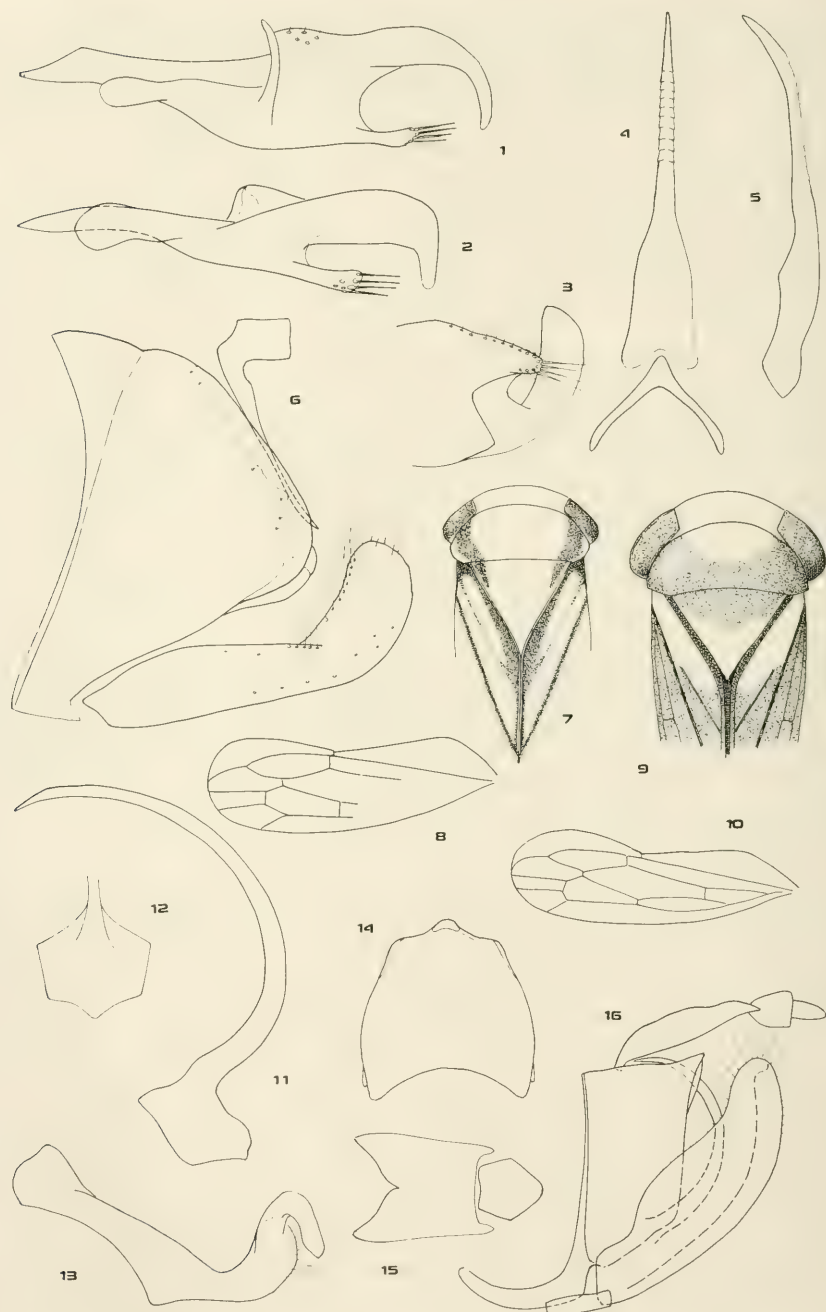
Holotype.— δ , British Guiana, near Mazaruni Hd, Pakaraima Mts., 1932. J. G. Myers. *Allotype*.— η , same data. Paratypes 5: Same data, 1 δ in JMC; 1 η from upper R. Pachitea, Peru, in the USNM.

The orange head, pronotum, and scutellum, the striking coloration of the forewings, and the genitalia easily distinguish this species.

Luteobalmus Maldonado-Capriles, new genus

Type-species: *Luteobalmus maculatus* Maldonado-Capriles, new species.

Vertex greenish yellow, remaining parts of face stramineous. Pronotum anteriorly with a semicircular greenish yellow area that extends from inner



Figs. 1-8. *Hyalocerus aurantius*. 1, style, lateral. 2, style, dorsal. 3, apex of style, ventral. 4, aedeagus and connective, caudal. 5, aedeagus, lateral. 6, genital capsule,

margin to inner margin of eyes; remaining parts brown. Forewings mostly transparent with a grayish brown tinge; veins dark brown; anterior $\frac{1}{2}$ of clavus yellow. Vertex about $2\times$ as wide as long (9:4); anterior and posterior margins parallel; pronotum about $2.5\times$ as wide as long (16:6), posterior margin shallowly concave. Scutellum slightly wider than long (12:10). Face slightly wider than long (19:18); anteclypeus bellshaped, longer than wide apically (5:3); lateral margins of postclypeus angled before midlength, UFS straight not reaching ocellus of corresponding side. Ocelli at about $2\times$ the distance from ocellus to eye (6:3). With short hairlike spine laterally below each eye. Lora flat, inconspicuous; lateral margin of gena shallowly concave. Forewing with 4 apical, 2 anteapical, and 1 discal cell. Tibiae oval in cross-section; spines of metatibia: r_1 and r_3 with 15–17 fine long, r_2 with 6–7 moderately strong, and r_4 with 35–40 short hairlike. Length 4.2 mm.

Male Genitalia.—Pygofer quadrangular in lateral aspect; upper apical angle produced mesad and sclerotized at apex. Aedeagus long, slender, curved cephalad, moderately wide at base. Valve in lateral aspect deepest at midlength, lower margin produced mesad at apex. Style as in Figs. 17 and 18. Tenth tergum long, flattened.

Female.—Coloration and shape much as in δ . Ovipositor about $5\times$ as long as abdominal sterna together, surpassing apex of wings; 7th sternum notched medianly.

Optocerus Freytag has a strong spinelike hair laterally below each eye whereas *Luteobalmus* has in some specimens a delicate hairlike spine in the corresponding position. The first genus has the outer apical cell pedunculate and the second has all apical cells quadrangular. In *Luteobalmus* the extremely long ovipositor of the female is striking, the produced apex of the valve is unusual, and the elongated nearly flattened tenth tergum is distinctive. The broken protective coloration of this genus, afforded by the yellowish on the clavus, is also found in the Pacific *Brachylorus*, *Meroleucocerus*, *Philippocerus* and *Idioscopus clavosignatus*. The name of this genus literally means anointed with yellow.

Luteobalmus maculatus Maldonado-Capriles, new species
(Figs. 9–16)

Male.—Vertex and forewings as described for genus. Scutellum anteriorly with a semicircular brown spot, remaining portion yellow. Apical

←

lateral. 7, anterior half, dorsal. 8, forewing. Figs. 9–16. *Luteobalmus maculatus*. 9, anterior half, dorsal. 10, forewing. 11, aedeagus, lateral. 12, base of aedeagus, caudal. 13, style, lateral. 14, connective, dorsal. 15, tenth tergum, dorsal. 16, genital capsule, lateral.

$\frac{1}{2}$ of 1st costal cell blackish brown. Pleurae, legs, and abdominal sterna pale stramineous.

Female.—Coloration as in δ . Vertex slightly over $3\times$ as wide as long (10:3); pronotum about $2.5\times$ as wide as long, posterior margin nearly straight; scutellum wider than long (13:11). Head slightly wider across eyes than long (20:18); postclypeus and anteclypeus as in δ ; ocelli apart at $2\times$ distance from ocellus to eye. Length 4.7 mm. Genitalia as in Figs. 11-16.

Holotype.— δ , British Guiana, New River, 750 ft, 26 March-2 April, 1938; C. A. Hudson collector. *Allotype*.— η , same data. Paratypes 5: from New River, same data as holotype, 2 with different dates; 1 δ in JMC.

The extensive yellowish area on the vertex and pronotum distinguish this species.

Pseudoidioscopus Maldonado-Capriles, new genus

Type-species: *Pseudoidioscopus bipunctatus* Maldonado-Capriles, new species.

Vertex stramineous, vitreous areas well defined. Pronotum grayish. Scutellum grayish on anterior $\frac{1}{2}$, mostly yellow on posterior $\frac{1}{2}$; triangular spot near each lateral angle lined with brown. Forewing hyaline, about same color of pronotum, with a brownish or grayish tinge; veins brownish, more conspicuous basally than apically.

Vertex with anterior and posterior margins parallel, curved, $7\times$ as wide as long (14:2). Pronotum $2.7\times$ as wide as long (22:8), posterior margin shallowly concave. Scutellum wider than long (15:10). Face wider across eyes than long (26:21); postclypeus with lateral margins angled at about midlength; UFS straight, ending just below ocellus of corresponding side. Anteclypeus bellshaped, slightly longer than wide apically (5:4). Ocelli apart at slightly less than $2\times$ distance from ocellus to eye (7:4). Spines of metatibia: r_1 —16 fine; r_2 —5 strong, the 1st 1 apart from the rest; r_3 —10 fine; and r_4 —35-40 hairlike spines about $\frac{1}{3}$ as long as diameter of segment, the last as large as those in r_1 .

Male Genitalia.—Valves with broad apex upcurved, as in Fig. 22. Aedeagus sickles shaped, slender, base slightly broad. Connective subtriangular, flattened. Pygofer with longitudinal fracture, semicircular, as in Fig. 21. Tenth tergum extending on each side into a complex pointed structure (Fig. 23). Style as in Figs. 17 and 18. Valve rectangular, posterior margin straight. Length 4.5 mm.

Female.—Coloration and shape much as in δ . Seventh sternum about as long as last 2 sterna together, apical margin convex. Ovipositor slightly surpassing pygofer. Length 4.8 mm.

With the general appearance of the Indian *Idioscopus*, hence the name

Pseudoidioscopus, and of some small *Idiocerus* as *I. capnus* Freytag. Their genitalia are totally different; the broad upcurved apex of the valve is unique. It can be separated from the genera discussed in this paper by the characters in the key.

Pseudoidioscopus bipunctatus Maldonado-Capriles, new species
(Figs. 17-24)

Male.—Vertex with short dash of brown medianly on hind margin. Pronotum with small brown spot near anterolateral angle, stramineous on lateral margin and along anterior margin to about midway between eye and median line. Scutellum with or without YY-brownish mark on disc. Face yellowish; vitreous areas and brown dash on vertex visible in front view; postclypeus with row of brownish spots each side of median line. Propleura brownish; meso- and metapleura straw colored or yellowish. Legs light brown; metatibia yellowish with brown spines. Abdominal sterna; first yellow, others pinkish; pygofer stramineous or grayish. First tergum yellow, next 3 black. Dimensions as described for the genus.

Female.—Shape and general coloration as in ♂. Vertex $5\times$ as wide as long (15:3). Pronotum $2.5\times$ as wide as long (23:9); scutellum $1.5\times$ as wide as long (16:10). Face across eyes slightly wider than long (23.5:22), postclypeus relatively broad, from ocelli to apex as long as wide across to base of UFS (11:11). Pygofer bare, slightly longer than abdominal sterna together (15:13); 7th sternum about as long as last 2 together, apical margin convex. Length 4.9 mm.

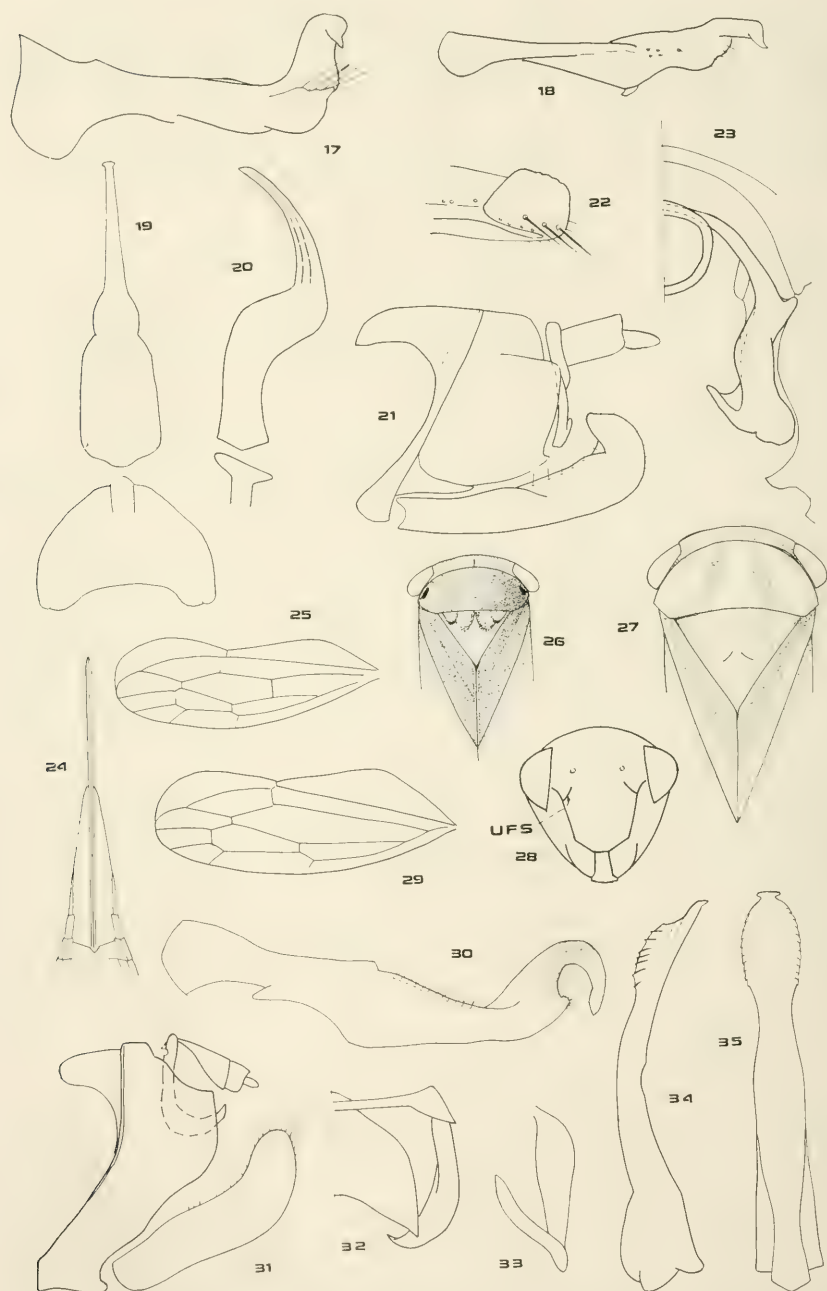
This species somewhat resembles *Idiocerus minutus* Osborn, but this species has two spots behind each eye and its face and pronotum are ornamented with reddish. The triangular spots of the scutellum are lined with brown not solid in color which is the usual condition.

Holotype.—♂, British Guiana, New River, 750 ft, May 4-5, 1938, C. A. Hudson collector. *Allotype*.—♀, March 26-April 2, 1938, C. A. Hudson. Paratypes 8: Seven, 1♀ labeled as allotype; 1♂, labelled as holotype, in JMC.

Corymbonotus Maldonado-Capriles, new genus

Type-species: *Corymbonatus bicolor* Maldonado-Capriles, new species.

Head, pronotum, and abdomen yellow; vertex and forewing ornamented with red. Vertex with margins parallel, $6\times$ as wide as long (19:3); pronotum elevated toward apical margin, slightly over $2\times$ as wide as long (30:14), posterior margin shallowly and broadly concave. Scutellum slightly elevated and swollen, wider than long (22:19). Forewing with 4 apical, 2 anteapical, and 1 discal cell, Fig. 29. Spines of metatibia: r_1 and r_2 ; respectively 12 and 17 finer, r_2 strong, r_1 35-50 hairlike spines. Face about



Figs. 17-26. *Pseudoidioscopus bipunctatus*. 17, style, lateral. 18, style, dorsal. 19, aedeagus and connective, dorsal. 20, aedeagus, lateral. 21, genital capsule, lateral. 22, apex of valve, dorsal. 23, appendix of tenth tergum, caudal. 24, genitalia, female.

as wide across eyes as long (32:31); UFS straight, reaching to below and slightly mesad of ocellus of corresponding side; ocelli set apart at $1.5\times$ distance from ocellus to eye (9:6); lateral margins of postclypeus angled at about midlength; anteclypeus bellshaped, slightly wider apically than long (6.5:6); lora slightly elevated; margin of gena straight.

Male Genitalia.—Plate flattened laterally at apex, with fine pilosity of medium length on upper margin of apical $\frac{1}{2}$. Pygofer subtriangular, deep and short. Tenth tergum flattened, horizontal, with L-shaped projection on each side of basal margin (Fig. 33). Aedeagus straight, vertical, relatively thick, apex expanded and scaly. Style with inner apical projection strongly sclerotized, dark; outer apical ledge produced, long pilosity. Valve rectangular, apical margin straight. Length 6.9 mm.

Female.—General coloration and shape about as in δ . Length 7.1 mm.

The robust size, the somewhat humped appearance, due to the slight elevation of the pronotum and slightly swollen scutellum, and the genitalia help to separate this genus from other idiocerines.

Corymbonotus bicolor Maldonado-Capriles, new species
(Figs. 27–35)

Male.—Vertex with posterior margin pale orange red; pronotum with L-shaped pale orange red marking each side of median line. Scutellum grayish yellow, with grayish triangular area near each basal angle. Lora and gena grayish, the latter with internal margin black. Pleura and legs grayish yellow; femora sometimes brownish basally and along anterior margin. Forewing hyaline, with stramineous tinge; clavus with anal cells orange red, outer cells yellow. Corium with basal angle orange red, veins to before apex of subapical cells hyaline, inconspicuous; apical veins of subapical and apical cells brown. Abdominal sterna and genital capsule yellowish. Dimensions and genitalia as described for genus.

Female.—Shape and coloration as described for genus. Longitudinal lines on pronotum straight; yellow on corium almost lacking. First segment of beak black. Seventh sternum brown medianly. Vertex $7\times$ as wide as long (21:3); pronotum $2.5\times$ as wide as long (31:12); scutellum wider than long (24:20). Face slightly wider across eyes than long (34:33); postclypeus and anteclypeus as in δ . Ocelli set apart at about $1.5\times$ distance from ocellus to eye. Length 7.1 mm.

Genitalia.—Seventh sternum slightly longer than VI, posterior margin

←

ventral. 25, forewing. 26, anterior half, dorsal. Figs. 27–35. *Corymbonotus bicolor*. 27, anterior half, dorsal. 28, face. 29, forewing. 30, style, lateral. 31, genital capsule, lateral. 32, tenth tergum, dorsal. 33, appendix of tenth tergum, caudal. 34, aedeagus, lateral. 35, aedeagus, caudal.

shallowly concave; pygofer $\frac{1}{3}$ longer than abdominal sterna together (19:14); ovipositor surpassing pygofers by $2\times$ its width.

Holotype.— δ , British Guiana, Amazon-Courantyne Divide. Head of Orinoco River, H. Beddington collector, 1937. *Allotype*.— η , British Guiana, New River, 750 ft, May 1–4, 1938, C. A. Hudson collector. Paratypes 4 δ δ ; 1 with same data as allotype, in JMC; 3 Katari Sources, January–February 1936, C. A. Hudson collector.

There is a possibility that the yellow areas are greenish yellow in life, either way, the large size, and the coloration easily identify the species.

Key to the New Genera Described in This Paper

1. Ocelli set apart at $2\times$ the distance from ocellus to eye; vertex $\frac{1}{2}$ or more length of pronotum 2
 - Ocelli set apart at $1.5\times$ or less the distance from ocellus to eye; vertex about $\frac{1}{4}$ as long as pronotum 3
2. Outer anteapical cell as wide basally as apically; η with ovipositor about $2\times$ as long as abdominal sterna together; orange and black 3

Hyalocerus n. gen.

 - Outer anteapical cell strongly narrowing basad; η with ovipositor very long, surpassing apex of forewings, $6-7\times$ as long as abdominal sterna together; gray, anterior $\frac{1}{2}$ of clavus whitish 3

Luteobalmus n. gen.
3. Large, δ 6.9 mm, η 7.1 mm; scutellum large, elevated at base, as long as distance from its apex to apex of clavus 3

Corymbonotus n. gen.

 - Small, δ 4.5 mm, η 4.7 mm; scutellum relatively smaller, not elevated, $\frac{1}{2}$ as long as distance from its apex to apex of clavus 3

Pseudoidioscopus n. gen.

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Department of Biology, University of Puerto Rico, Mayaguez, Puerto Rico 00708.

NOTES ON THE SPECIES OF *NEORHIZOECUS* HAMBLETON,
A SYNONYM OF *RHIZOECUS* KÜNCKEL D'HERCULAIS
(HOMOPTERA: PSEUDOCOCCIDAE)

Edson J. Hambleton

Abstract.—Notes and illustrations are given on the five species of *Rhizoecus* previously included in *Neorhizoecus* together with diagnostic species characters, hosts, and distribution records.

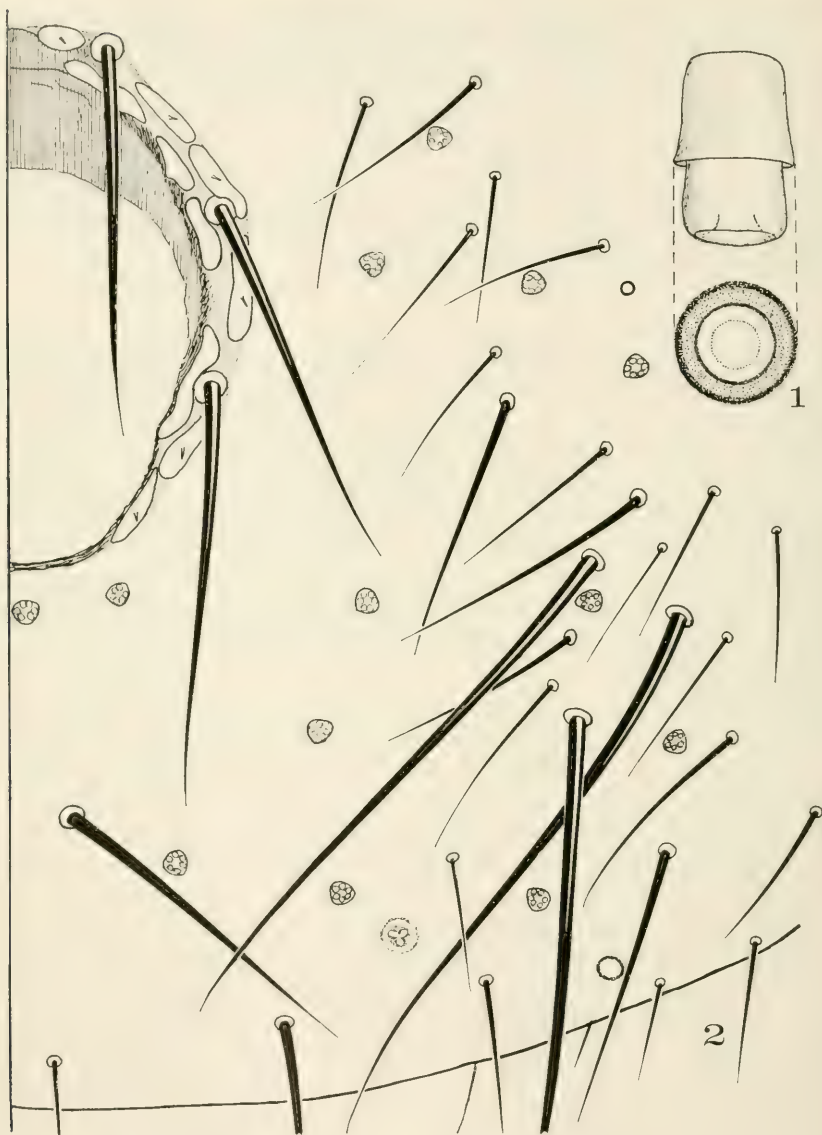
In 1946, I published a description of the genus *Neorhizoecus* to accommodate four neotropical species that closely resembled *Rhizoecus* Künckel d'Herculaïs. The diagnostic features of *Neorhizoecus* are its oval body shape, 5-segmented antennae, short setose digitules, absence of eyes and tubular cerores. Williams (1970) described a fifth species *N. epicopus* from Barbados and Trinidad with tritubular cerores, and noted that these structures were also present on *N. coffeae* (Laing), the type-species. After verifying these observations, I located a single ceroris in each of two paratypes of *N. setosus* Hambleton. Examination of 56 additional specimens of *N. setosus* from Colombia and Peru indicated as many as 10 cerores on a single specimen, the Colombian specimens each averaged 4-5 cerores, and those from Peru 7-8.

The presence of cerores in three of the five species of *Neorhizoecus* and the intraspecific variation in these structures clearly eliminates the "absence of cerores" as a usable diagnostic character for the genus. The remaining features which characterize *Neorhizoecus* also lose their significance because they are equally applicable to *Rhizoecus*. For example, of the 52 recognizable American species of *Rhizoecus*, five have 5-segmented antennae, 26 have short, setose digitules, and six have no eyes. Consequently *Neorhizoecus coffeae* should be returned to *Rhizoecus*; *Neorhizoecus setosus* and *N. epicopus*, by virtue of their having cerores, should be placed in *Rhizoecus*. Although *Neorhizoecus andensis* Hambleton and *N. colombiensis* Hambleton have no cerores, it would seem logical for the time being to place them in *Rhizoecus* because their other characters agree generically.

The inclusion of the five *Neorhizoecus* taxa in *Rhizoecus* should broaden its composition and facilitate placement of some intermediate forms with characteristics of both *Neorhizoecus* and *Rhizoecus*. I therefore propose that the name *Neorhizoecus* be synonymized with *Rhizoecus*, and new name combinations be given accordingly.

Genus *Rhizoecus* Künckel d'Herculaïs

Rhizoecus Künckel d'Herculaïs, 1878:163. Type-species: *Rhizoecus falcifer* Künckel d'Herculaïs.



Figs. 1-2. *Rhizoecus coffeae*, female. 1. tubular duct, lateral and ventral. 2, anal ring, right half, and right anal-lobe area.

Neorhizoecus Hambleton, 1946:40. Type-species: *Neorhizoecus coffeae* Hambleton. New Synonym.

Rhizoecus andensis (Hambleton), new combination
(Figs. 15-18)

Neorhizoecus andensis Hambleton, 1946:41.

This species and *Rhizoecus colombiensis* (Hambleton) are the only known members of the genus without tubular cerores. *Rhizoecus andensis* is readily separated from *R. colombiensis* by having multilocular disk pores, no circulus, and distinctly shaped antennae and sensory setae. *Rhizoecus andensis* is known only from Colombia where it occurs on *Coffea arabica*.

Specimens Examined: Six ♀♀ mounted on 2 slides represent the syntype series of *Neorhizoecus andensis* from Bogota, Colombia, 22-II-1935, L. Murillo. I have selected the specimen nearest the label on slide #1 as the *lectotype*. The same slide contains 2 paralectotypes. Types in USNM. La Esperanza, 15-XI-1935, René Paul Robá (10♀♀, B.M.); locality (?), VIII, 1955, D. Rios Castana (4♀♀, USNM); locality (?), IV-1956, S. G. Flanders, (4♀♀, USNM); Chinchina, Cald., 18-XII-1975, R. Cardenas (24♀♀, USNM).

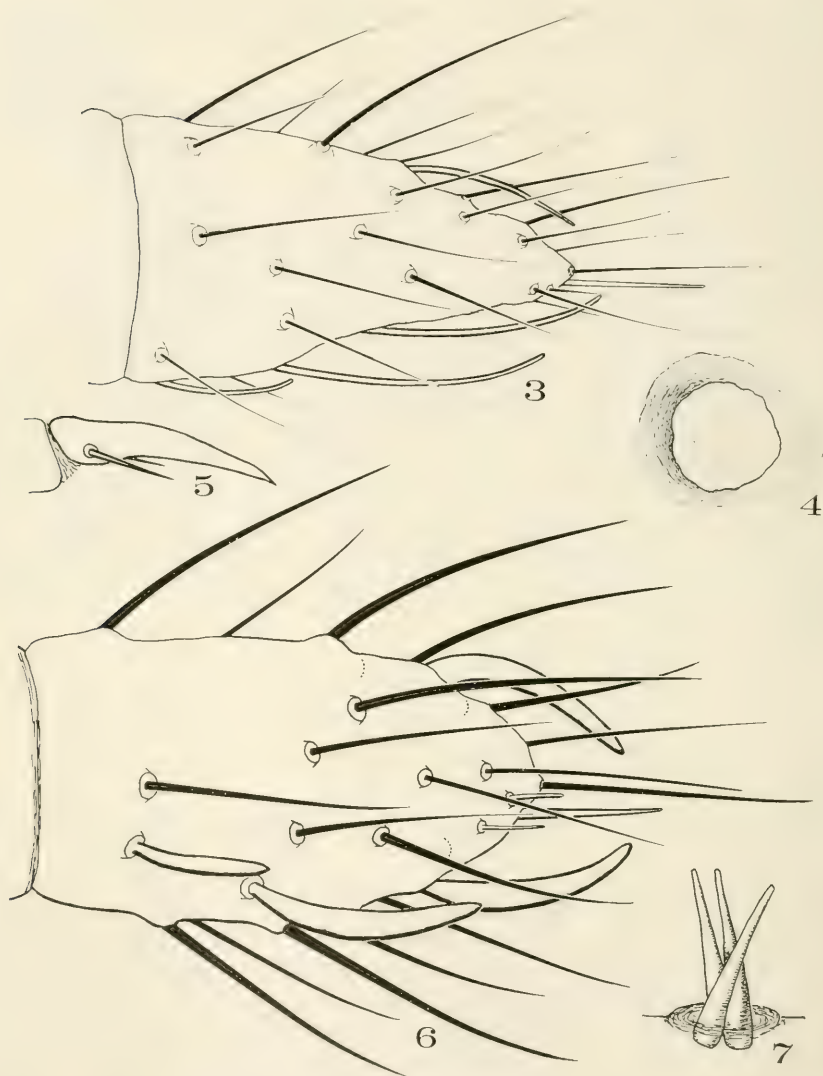
Rhizoecus coffeae Laing
(Figs. 1-2, 5-7)

Rhizoecus coffeae Laing, 1925:384.

Rhizoecus lendea Pickel, 1927:591.

Neorhizoecus coffeae: Hambleton, 1946:42; Ferris, 1953:386; Williams, 1970:155.

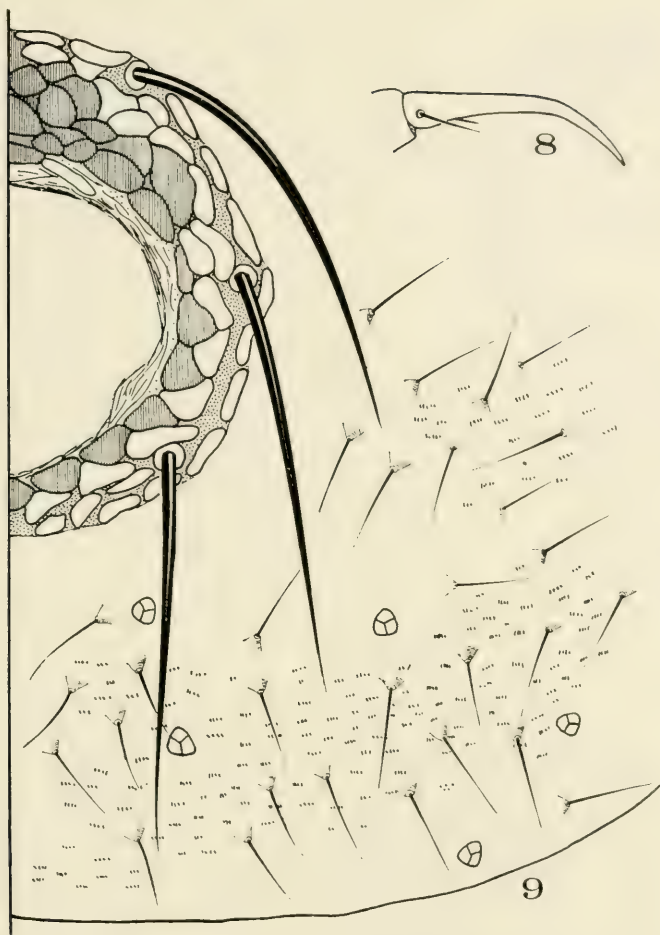
The selection of *Rhizoecus coffeae* Laing as the type-species of *Neorhizoecus* was erroneous because it possesses tritubular cerores and elongate anal-lobe setae. The species is here returned to its original combination. *Rhizoecus coffeae* resembles *R. setosus* (Hambleton) but may be distinguished from it by the more elongate anal-lobe setae and by the size of its tritubular cerores. The cerores in *R. coffeae* are small, 4-5 μ in diameter at their base, with slender, tapering ducts. Under low magnification they resemble circular pustules with broad borders. Dorsally there are 6-8 cerores on the head, 18-20 on thorax, and 48-50 on abdomen; occasionally a few occur ventrally. The cerores in *R. setosus* are much larger and occur in small numbers, from 0-11 are usually present. In both *R. setosus* and *R. coffeae* there are 2 short, slender, weakly curved sensory setae near the distal extremity of antennal segment V. These setae have also been observed in *R. andensis* but are not known to be present in other *Rhizoecus*.



Figs. 3-4. *Rhizoecus colombiensis*, female. 3, terminal segment of antenna. 4, circulus. Figs. 5-7. *Rhizoecus coffeae*, female. 5, hind claw. 6, terminal segment of antenna. 7, tritubular cerosis, lateral.

The known distribution of this coffee pest is Brazil, Costa Rica, Surinam and Venezuela.

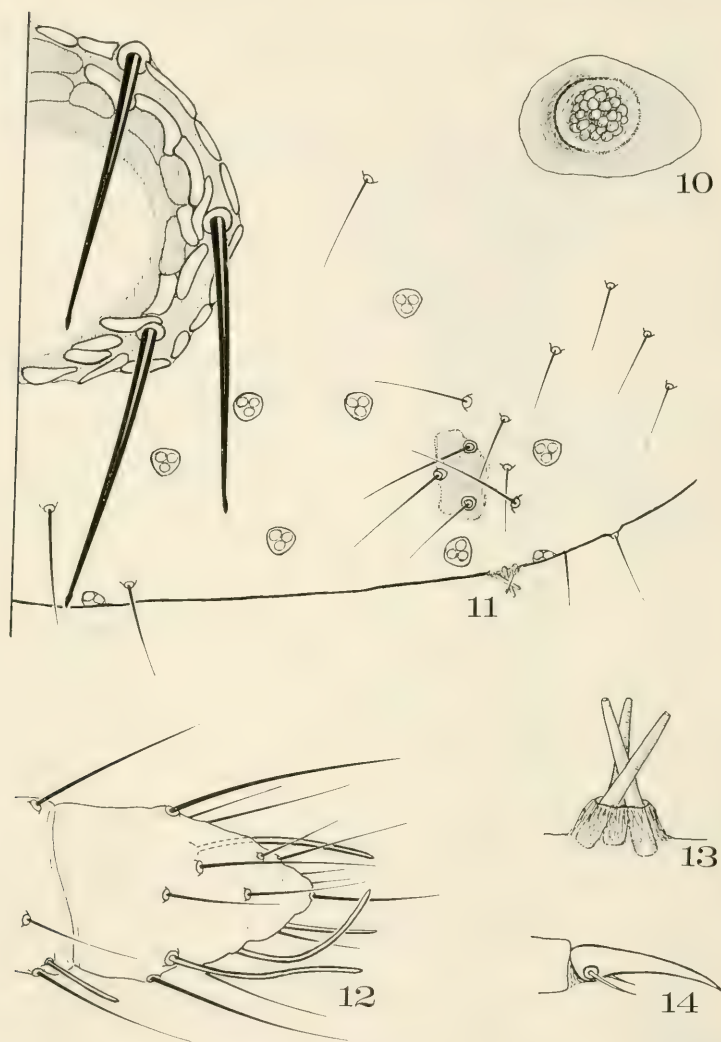
Specimens Examined: *Holotype*, Paramaribo, Surinam, 13-V-1924, A. Reyne (Br. Mus.); same locality, 10-VII-1932, D. G. Bunzli (6♀♀, 4♂♂,



Figs. 8-9. *Rhizococcus colombiensis*, female. 8, hind claw. 9, anal ring, right half, and right anal-lobe area.

Br. Mus.); Bananeiras, Parahíba, Brazil, IX-1927, D. B. Pickel (6 ♀♀, USNM); Caruarú, Pernambuco, Brazil, 14-XII-1927, D. B. Pickel, 1-XI-1928, (3 ♀♀, USNM); Alajuela, Costa Rica, 14-VIII-1950, R. A. Davis (5 ♀♀, Br. Mus.); Alajuela, Costa Rica, 28-V-1932, 22-X-1951, R. Escheveria, et al. (50 ♀♀, USNM); Caraboba and Monagas, Venezuela, 12-V, 13-VII-1935, Shell Oil Co. (26 ♀♀, USNM).

Additional hosts of *R. coffeae* include *Axonopus compressus*, *Caladium bicolor*, *Coffea liberica*, *Cyperus chalaranthus*, *C. elegans* and *C. luzulae*.

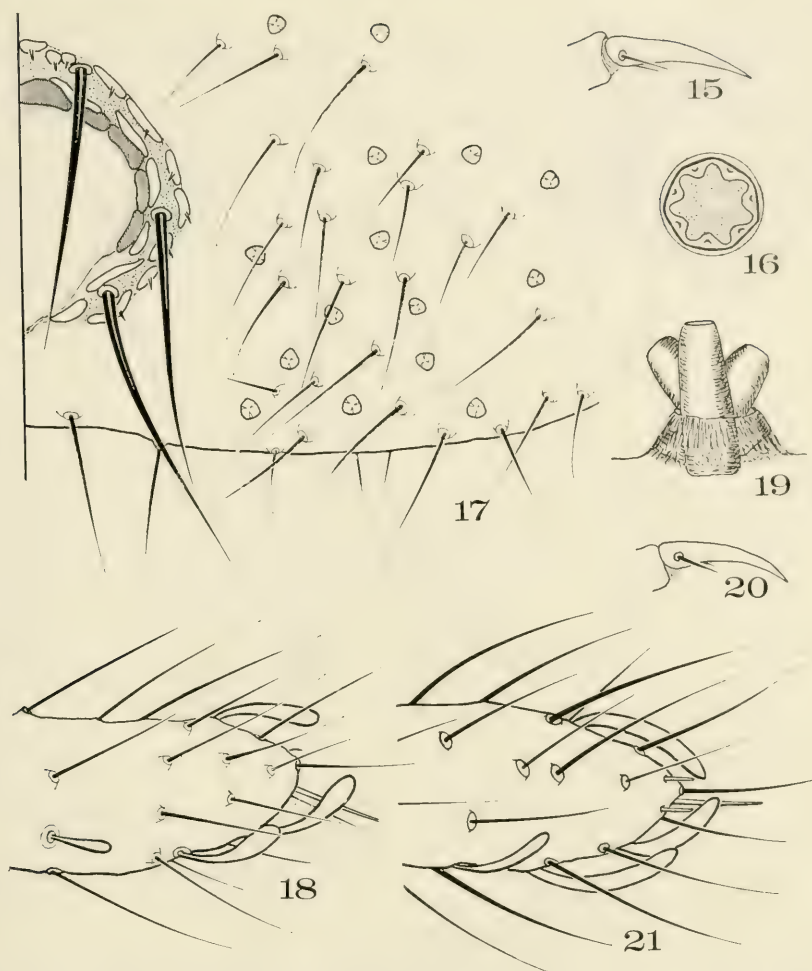


Figs. 10-14. *Rhizoecus epicopus*, female. 10, circulus. 11, anal ring, right half, and right anal-lobe area. 12, terminal segments of antenna. 13, tritubular ceroris, lateral. 14, hind claw.

Rhizoecus colombiensis (Hambleton), new combination
(Figs. 3-4, 8-9)

Neorhizoecus colombiensis Hambleton, 1946:43.

The important diagnostic characters of *R. colombiensis* are its very slender sensory setae, the well-structured anal ring, the disposition of the



Figs. 15-18. *Rhizoeus andensis*, female. 15, hind claw. 16, multilocular disk pore. 17, anal ring, right half, and right anal-lobe area. 18, terminal segment of antenna. Figs. 19-21. *Rhizoeus setosus*, female. 19, tritubular ceroris, lateral. 20, hind claw. 21, terminal segment of antenna.

short body setae in bands around the segments and the absence of tubular cerores and differentiated anal-lobe setae. Presumably, 1 circulus in the adult female is normal, however, 1 of 2 preadult females mounted with the holotype has a smaller circulus on the venter of abdominal segment III. This species is known only from the type-locality; its host is unknown.

Specimens Examined: *Holotype*, La Esperanza, Colombia, II-1936, René Paul Robá, and 2 paratypes, on same slide (USNM).



Fig. 22. *Rhizoecus setosus*, female; anal ring, right half, and right anal-lobe area.

Rhizoecus epicopus (Williams), new combination
(Figs. 10-14)

Neorhizoecus epicopus Williams, 1970:155.

The characteristic features of *R. epicopus* are its anal-ring setae with flattened or swollen apices, 4- to 6-segmented antennae, the narrow, elongate sensory setae, and the anal lobes each with 3-4 setae in a small sclerotized area. The anal-lobe setae are slightly longer than the short, slender body setae. This species should not be confused with *R. colombiensis* which it only slightly resembles. The anal ring of *R. epicopus* averages

59 μ wide compared to 77 μ for that of *R. colombiensis*. There are no cerores or differentiated anal-lobe setae in *R. colombiensis*, and the antennae are differently shaped.

Rhizoecus epicopus is known only from Barbados and Trinidad where it is a pest of sugarcane.

Specimens Examined: *Holotype* and 1 paratype, Barbados, on *Saccharum officinarum*, 1952, R. W. E. Tucker (Br. Mus.); 4 paratypes, same location and data (USNM); 3 paratypes, Woodford Lodge Estate, Trinidad, 30-VI-1948, R. G. Fennah (USNM).

Rhizoecus setosus (Hambleton), new combination
(Figs. 19-22)

Neorhizoecus setosus Hambleton, 1946:46.

In general appearance *R. setosus* resembles *R. coffeae*, but the tubular cerores in *R. setosus* are larger and occur in fewer numbers, or may be absent, with no more than 11 in a single specimen; in *R. coffeae* there may be as many as 78. The multilocular disk pores in *R. setosus* occur only on the abdomen, whereas in *R. coffeae*, they are also scattered near the spiracles. See discussion under *R. coffeae*. In *R. setosus* the 3 anal-lobe setae are stouter and slightly longer than most body setae. *Rhizoecus setosus* is known from Colombia, Ecuador and Peru.

Specimens Examined: *Holotype* and 4 paratypes, Pichilingue, Ecuador, on undetermined Piperaceae, 30-IX-1944, E. J. Hambleton (USNM); Tingo Maria, Peru, 3-VI-1948, E. J. Hambleton (19♀♀, USNM); Supata, Cundinamarca Prov., Colombia, 22-X-1975, F. Mosquera (37♀♀, USNM).

Additional hosts include *Coffea arabica*, *Heliconia* sp. and an undetermined Gramineae.

Acknowledgments

I thank Dr. Douglas J. Williams, British Museum (Natural History), London, for the loan of type-material, and Dr. Douglass R. Miller, Systematic Entomology Laboratory, IIBIII, Agric. Res. Serv., USDA, Washington, D.C. for reviewing the manuscript.

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DICRANORCHESELLA, A NEW GENUS OF SPRINGTAILS
FROM MEXICO (COLLEMBOLA: ENTOMOBRYIDAE)

José A. Mari Mutt

Abstract.—*Dicranorchesella boneti*, a new genus and species from Mexico, is described and differentiated from its closest relatives, the genera *Dicranocentrus* and *Orchesella*. A key to the genera of Orchesellini with six segmented antennae is presented.

During the course of a revision of the genus *Dicranocentrus*, some specimens, identified as belonging to that genus, were received from Dr. F. Bonet. Careful study revealed that a new genus must be erected for these specimens.

Since, in some important morphological characters, this new genus appears intermediate between the genera *Dicranocentrus* Schött and *Orchesella* Templeton, I have named it *Dicranorchesella*. The species is named *D. boneti* after Dr. Bonet who collected most of the material and kindly forwarded it for study.

Dicranorchesella Mari Mutt, new genus

Orcheselline in general body appearance. Body covered by elongated fusiform shaped scales (Fig. 3a-c) which are absent from antennae, legs, and collophore and by finely ciliated short setae in addition to macrochaetae, microchaetae, and lasiotrichiae. Ciliated setae present throughout legs. Smooth setae present on inner face of tibiotarsi. Antennae 6-segmented with last 2 segments annulated. Eyes, 8 to each side of the head; A and B are the largest, G and H are the smallest. Postantennal organ absent. Collarette present. General dorsal head macrochaetotaxy pattern as in Fig. 5d; dorsal body macrochaetotaxy as in Fig. 6d. Claw structure (Fig. 2) as in most Entomobryinae; unguis with 2 inner teeth and a distal unpaired tooth. Unguiculus with a tooth on 1 of the outer lamellae. Dental spines present, long, stout, simple, arranged in a row on proximal inner dorsolateral margin of dentes (Fig. 1). Mucro consisting of 2 teeth and a basal spine.

Type-species.—*Dicranorchesella boneti*, n. sp.

Diagnosis and Discussion.—*Dicranorchesella* is closely related to *Dicranocentrus* and *Orchesella* but may be readily separated from these genera by the following key.

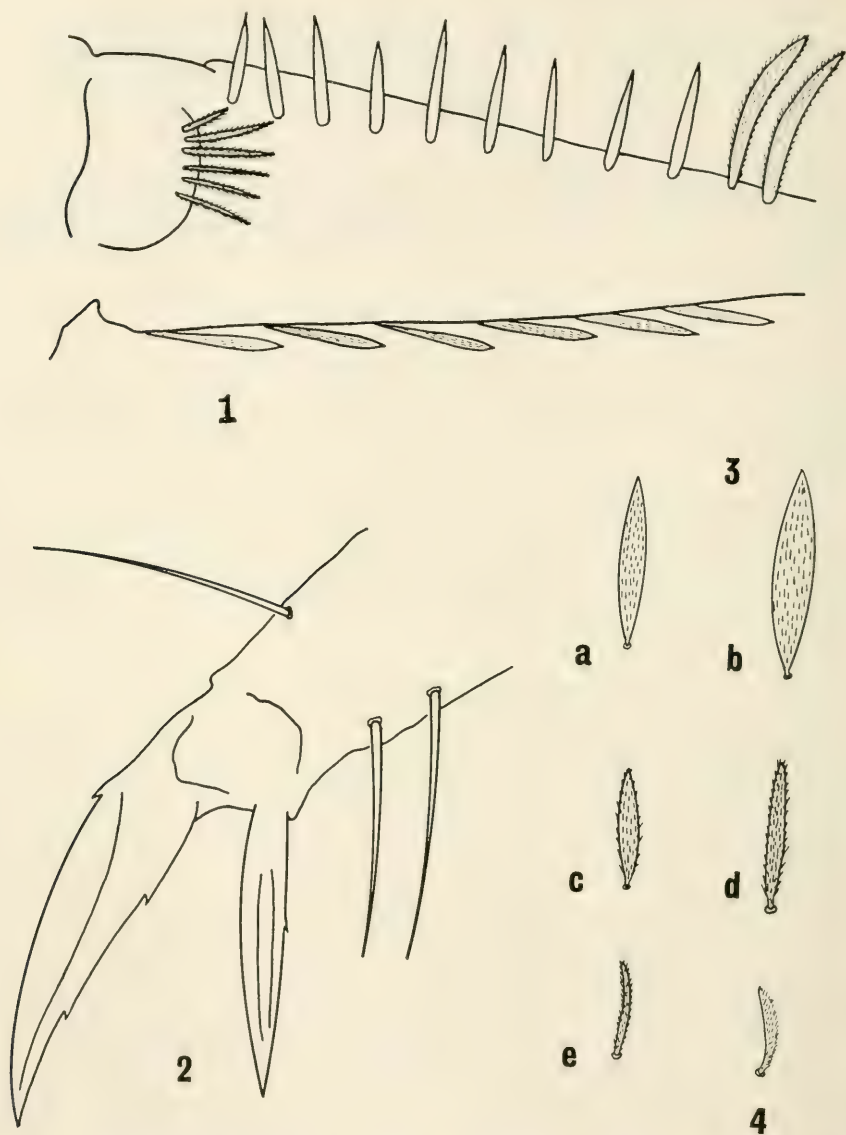


Fig. 1. Lateral view of the dens showing the arrangement of the dental spines. Fig. 2. Claw structure of the posterior left leg. Fig. 3. a-c, scales. d-e, intermediate structures between scales and setae. Fig. 4. Ciliated seta of the type that covers the head and body.

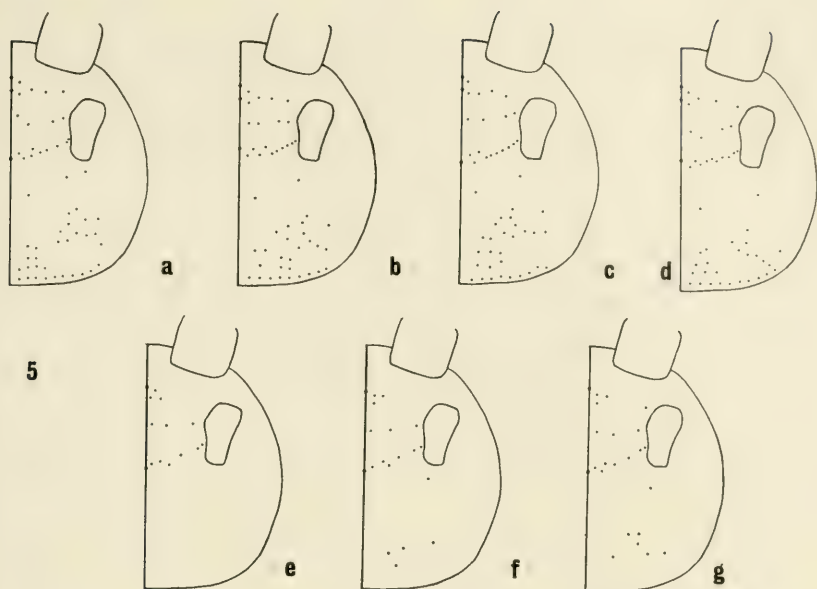
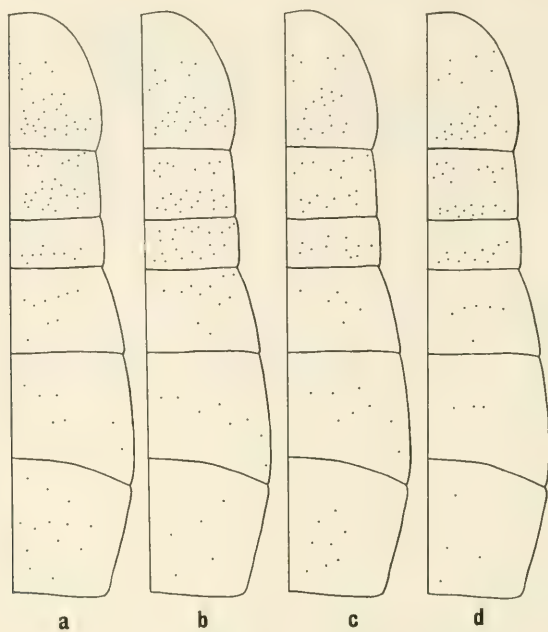


Fig. 5. Dorsal head macrochaetotaxy (each dot represents a seta). a. *Orchesella* sp. 1, b. *O.* sp. 2, c. *O. ainsliei*, d. *Dicranorchesella boneti*, e. *Dicranocentrus marias*, f. *D. gracilis*, and g. *D. sundanensis*.

Key to the Genera of Orchesellini Possessing Six Segmented Antennae

1. Scales absent *Orchesella* Templeton
- Scales present 2
2. Scales variable in size and shape but not fusiform, usually apically rounded or truncated; scales present on the 1st 4 antennal segments and on all segments of legs; short ciliated setae (Fig. 4) absent *Dicranocentrus* Schött
- Scales similar in size and fusiform in shape (Fig. 3a–c); absent from antennae and legs; short ciliated setae present *Dicranorchesella*, n. gen.

There is a close taxonomic relationship between these genera. Figures 5–6 present the head and body macrochaetotaxy of three species of *Dicranocentrus*, three species of *Orchesella* (sp. 2 was collected sympatrically with *D. boneti* in locality No. 6, see Material Examined), and the new genus and species, *Dicranorchesella boneti*. A comparative study of these figures reveals that *Dicranorchesella* has a macrochaetotaxy which is very similar to the pattern observed in the genus *Orchesella*, and distinctly different, although common elements exist, from that of the genus *Dicrano-*



centrus. Furthermore, *Dicranorchesella* also shares with *Orchesella* the presence of short ciliated setae which are absent in *Dicranocentrus*.

On the other hand, *Dicranorchesella* shares with *Dicranocentrus*, and not with *Orchesella*, the presence of scales and dental spines, while differing from *Dicranocentrus* in the characters given in the key and in the head and body macrochaetotaxy.

Dicranorchesella boneti Mari Mutt, new species

Length of adults to 3.5 mm, averaging 2.6 mm ($n = 27$). Background color of body and appendages light yellow to light brown. Light purple pigment present throughout specimens in the following way: Antennae heavily pigmented throughout, the pigment being more intense on apical portions of segments. Head deeply pigmented on anterior $\frac{1}{2}$, pigment surrounding mouth cone. Diffuse pigment present between eyes and antennal bases but forms no definite clear-cut band, as may be found in many species of *Dicranocentrus*. Legs deeply and evenly pigmented throughout, the pigment being more evident on posterior halves of the segments, especially at boundary with next somite. Manubrium evenly pigmented, in more heavily colored specimens the pigment extends to anterior portion of dentes. Collophore diffusely pigmented throughout. Pigment intensity and distribution rather variable intraspecifically; some specimens nearly evenly blue. Antennal segment 6 subequal in length to segment 5. Tibiotarsi with rows of smooth setae on inner margin. Claw structure as in Fig. 2. Tenent hair lanceolate. Dental spine arrangement as in Fig. 1. Head and body macrochaetotaxy as in Figs. 5d and 6d.

Material Examined (All from Mexico).—1) Hidalgo, Chapulhuacán, 3 kms from town at Km 339.800 of the road Mexico-Laredo, 910 m cl., April 5, 1942, very moist leaf mold and rotten wood in tropical rain forest, F. Bonet, coll. *Holotype*, 20 paratypes, and 8 immatures. 2) As the preceding but collected on May 26, 1944. Three paratypes and 9 immatures. 3) Veracruz, Fortín, along the road from Fortín to Córdoba, 900 m cl., January 15, 1952, leaf mold under coffee, plantain, and other trees, F. Bonet, coll. Three paratypes and 4 immatures. 4) Veracruz, Coscomatepec de Bravo, November 12, 1943, leaf mold, M. Cardenas, coll. One immature. 5) San Luis Potosí, Tamazunchale, 5 kms south of town, Km 363 on road Mexico-Laredo, 160 m cl., May 20, 1944, moist leaf mold in tropical rain forest, F. Bonet, coll. Two paratypes. 6) San Luis Potosí, Tamazunchale,

←

Fig. 6. Dorsal body macrochaetotaxy (each dot represents a seta). a. *Orchesella* sp. 1, b. *O.* sp. 2, c. *O. ainsliei*, d. *Dicranorchesella boneti*, e. *Dicranocentrus marias*, f. *D. gracilis*, and g. *D. sundanensis*.

March 15, 1948, debris from banana plantation, C. H. Seevers, coll. One paratype.

Material Repository.—Illinois Natural History Survey has holotype, 14 paratypes, and all immatures from locality no. 1 and all the material from localities 2–6. F. Bonet collection (Instituto Mexicano del Petroleo, Mexico 14 D. F.) has five paratypes from locality no. 1. Field Museum of Natural History (Chicago, Illinois) has one paratype from locality no. 1.

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THE MEXICAN SPECIES OF *CHALCIS* FABRICIUS
(HYMENOPTERA: CHALCIDIDAE)

B. D. Burks

Abstract.—Three new species of *Chalcis* Fabricius from Mexico are described: *nodis*, *colpotis*, and *celis*. A key and descriptions are given of all species of *Chalcis* new known to occur in Mexico. A list is included that shows the current generic placement of all Mexican species described or previously placed in *Smicra* (or *Smiera*) Spinola. At present *Smicra* is considered to be a synonym of *Chalcis* Fabricius.

The species of *Chalcis* Fabricius that have been reared are parasites in larvae of stratiomyiid flies. It is likely this is true for all the species, because the adults of *Chalcis* can be collected only in or near aquatic habitats where stratiomyiids are common.

Stratiomyiids deposit their eggs in flat masses on vegetation or other objects just above the water line in cattail bogs or other sloughs. The adult female *Chalcis* has an ovipositor minute enough to pierce a stratiomyiid egg without destroying it. Several species have been observed to feed on some of these eggs but to deposit their eggs in others. It is only while these host eggs are exposed above the water line that stratiomyiids are vulnerable to attack by *Chalcis*.

When a parasitized stratiomyiid egg hatches, the larva migrates into the water, carrying within itself the *Chalcis* embryo. The parasite remains inside the stratiomyiid larva throughout development of the stratiomyiid. When the stratiomyiid larva is mature, it migrates out of the water to pupate in the mud just above the water line. Then the *Chalcis* larva develops rapidly, pupates, and emerges as an adult through a hole it cuts in the skin of the stratiomyiid.

The life history of several species of *Chalcis* has been studied. See Schremmer (1960) for a life history of *Chalcis myrifex* (Sulzer), a common European species.

In the taxonomic literature the Mexican species that are now placed in *Chalcis* Fabricius were placed in the genus *Smicra* (sometimes spelled *Smiera*) Spinola, until 1923. That year Gahan and Fagan (1923) published the statement that *Smicra* and *Chalcis* were isogenotypic and that, as a result, *Smicra* (being more recently described) should be placed as a synonym of *Chalcis*. Further, the name *Chalcis*, long applied to another common chalcidid genus, should be used in the sense of *Smicra*. The species that at that time were placed under *Chalcis* should be placed instead under the generic name *Brachymeria* Westwood. This rather drastic change in the application of commonly used names was accepted by all

subsequent workers except Schmitz, who published on the African Congo species of Chalcididae (Schmitz, 1946).

By the present time an enormous literature has accumulated in which the names *Chalcis* and *Brachymeria* are used as specified by Gahan and Fagan. However, this change in the application of these names was not based on a study of type-specimens but was mostly culled from the "Catalogus Hymenopterorum," published by Dalla Torre (1898). That work is bibliographic and not taxonomic. This case rests largely on an opinion of Dalla Torre about the misidentification of the species *Sphex sispes* Linnaeus by Fabricius in 1789. This is a matter that most certainly should have been submitted to the Secretary of the International Commission on Zoological Nomenclature. This was not done, but instead, Gahan and Fagan simply published statements that the changes should be made.

It would not, at this late date, be advisable to reopen this question and possibly reverse the usage that now has been followed for over 50 years. The Gahan and Fagan application of the name *Chalcis* has been adhered to in recent revisional works that cover a large part of the fauna of the world. It is necessary, however, considering present day usage of the name *Chalcis*, to recatalog all the Mexican species that were placed in *Smicra*, or *Smiera*, before 1923. This is required so that the application of the name *Chalcis* to Mexican species in this present paper may be clear. All the Mexican species that were placed in *Smicra*, or *Smiera*, before 1923 cannot automatically be transferred to *Chalcis*, because *Chalcis* itself has been re-defined since 1923 (Burks, 1940). Most of the old *Smicra*, or *Smiera*, species go into genera other than *Chalcis*.

Accordingly, a list has been prepared that includes all Mexican species that were described or placed in *Smicra*, or *Smiera*, before 1923. This list is given below; in it a heading gives the present generic placement of each species. This is followed by the reference to the original description, information about the type-specimens, and, for some, pertinent ancillary information. The species are arranged alphabetically by species names. I have seen the types of all of these species except for a few that seem to be lost. Many of the generic placements in this list have not previously been published. The following abbreviations are used for repositories of types: ANSP for Academy of National Sciences, Philadelphia; BM for British Museum (Natural History), London; MHNP for Musée d'Histoire Naturelle, Paris; USNM for National Museum of Natural History, Washington, D.C.

Mexican Species Described or Placed in *Smicra*, or
Smiera, Spinola Before 1923

Spilochalcis abdominalis (Walker), new combination

Smiera abdominalis Walker, 1861, J. Entomol. 1:177, ♂. Type: BM 5.480.

Spilochalcis, *xanthostigma* species group.

Spilochalcis ambigua (Cresson), new combination

Smicra ambigua Cresson, 1872, Trans. Amer. Entomol. Soc. 4:44, ♂. Type: ANSP 1807. Synonym of *abdominalis* Walker. NEW SYNONYMY.

Spilochalcis ardens (Cameron), new combination

Smicra ardens Cameron, 1897, Ann. Mag. Nat. Hist. (Ser. 6) 19:262, ♀. Type: BM 5.209. *Spilochalcis, femorata* species group.

Chalcis armillata (Cameron), new combination

Smicra armillata Cameron, 1897, Ann. Mag. Nat. Hist. (Ser. 6) 19:264, ♂. Type: BM 5.169. Synonym of *barbara* Cresson. NEW SYNONYMY.

Spilochalcis azteca (Cresson), new combination

Smicra azteca Cresson, 1872, Trans. Amer. Entomol. Soc. 4:51, ♂. Type: ANSP 1820. *Spilochalcis, nigricornis* species group.

Spilochalcis centralis (Cameron), new combination

Smicra centralis Cameron, 1884, Biol. Cent.-Amer., Hym., v. 1, p. 89, pl. 5, fig. 6, ♀. Type: BM 5.214. *Spilochalcis, femorata* species group.

Thaumapus coccinatus (Cresson), new combination

Smicra coccinata Cresson, 1872, Trans. Amer. Entomol. Soc. 4:48, ♂. Type: ANSP 1809.

Metadontia compactilis (Cresson), new combination

Smicra compactilis Cresson, 1872, Trans. Amer. Entomol. Soc. 4:50, ♀. Type: ANSP 1818.

Smicra conjungens Walker

Smicra conjungens Walker, 1871, Notes on Chalc., p. 53, ♂. Type: Supposed to be in MHNP, but could not be located; not in BM. Probably *Spilochalcis*.

Spilochalcis dimidiata (Sichel), new combination

Conura dimidiata Sichel, 1865, Ann. Soc. Entomol. de France (Ser. 4) 5:360, 390, "♀" = ♂. Type: MHNP, 1 ♂. Placed in *Smicra* by Cresson, 1872, Trans. Amer. Entomol. Soc. 4:55. *Spilochalcis, dimidiata* species group.

Chalcis divisa (Walker)

Smiera divisa Walker, 1861, J. Entomol. 1:178, ♀, ♂. Type: BM 5.464.
Placed in *Chalcis* by Burks, 1940, Proc. US Natl. Mus. 88:246.

Spilochalcis erythrina (Walker), new combination

Smiera erythrina Walker, 1861, J. Entomol. 1:179, "♀" = ♂. Type: BM 5.469. *Spilochalcis, femorata* species group. *Spilochalcis clora* Burks, 1940, Proc. US Natl. Mus. 88:306, ♂, is a synonym. NEW SYNONYMY.

Spilochalcis exornata (Cresson)

Smiera exornata Cresson, 1872, Trans. Amer. Entomol. Soc. 4:50, ♂. Type: ANSP 1817. *Spilochalcis, transitiva* species group. Placed in *Spilochalcis* by Burks, 1940, Proc. US Natl. Mus. 88:206.

Spilochalcis fasciola (Cameron), new combination

Smiera fasciola Cameron, 1897, Ann. Mag. Nat. Hist. (Ser. 6) 19:264, ♀. Type: BM 5.212. *Spilochalcis, femorata* species group.

Spilochalcis flammeola (Cresson)

Smiera flammeola Cresson, 1872, Trans. Amer. Entomol. Soc. 4:48, ♀, ♂. Type: ANSP 1811. *Spilochalcis, nigricornis* species group. Placed in *Spilochalcis* by Burks, 1940, Proc. US Natl. Mus. 88:296.

Spilochalcis flavovariegata (Cameron), new combination

Smiera flavovariegata Cameron, 1884, Biol. Cent.-Amer., Hym., v. 1, p. 92, ♀, ♂. Type: BM 5.205 (labelled *fulvovariegata*). *Spilochalcis, femorata* species group.

Spilochalcis geniculata (Cameron), new combination

Smiera geniculata Cameron, 1884, Biol. Cent.-Amer., Hym., v. 1, p. 87, ♂. Type: BM 5.201. *Spilochalcis, femorata* species group.

Spilochalcis juxta (Cresson)

Smiera juxta Cresson, 1872, Trans. Amer. Entomol. Soc. 4:54, ♀. Type: ANSP 1808. *Spilochalcis, xanthostigma* species group. Placed in *Spilochalcis* by Burks, 1940, Proc. US Natl. Mus. 88:311.

Thaumapus lamyrus (Walker), new combination

Smiera lamyrus Walker, 1842, Entomologist for 1842, p. 337, ♀. Type: BM 5.503.

Spilochalcis lauta (Cresson), new combination

Smicra lauta Cresson, 1872, Trans. Amer. Entomol. Soc. 4:45, ♀. Type: ANSP 1806. *Spilochalcis*, *xanthostigma* species group.

Spilochalcis lecta (Cresson)

Smicra lecta Cresson, 1872, Trans. Amer. Entomol. Soc. 4:44, ♀, ♂. Type: ANSP 1805. *Spilochalcis*, *xanthostigma* species group. Placed in *Spilochalcis* by Burks, 1940, Proc. US Natl. Mus. 88:317.

Spilochalcis lenta (Cresson), new combination

Smicra lenta Cresson, 1872, Trans. Amer. Entomol. Soc. 4:52, ♂. Type: ANSP 1821. *Spilochalcis*, *lenta* species group.

Spilochalcis mendica (Cresson)

Smicra mendica Cresson, 1872, Trans. Amer. Entomol. Soc. 4:41, ♂. Type: ANSP 1802. *Spilochalcis*, *side* species group. Placed as synonym of *Spilochalcis flavopicta* (Cresson) by Burks, 1940, Proc. US Natl. Mus. 88:331.

Psychidosmicra mexicana (Cresson), new combination

Smicra mexicana Cresson, 1872, Trans. Amer. Entomol. Soc. 4:42, ♀, ♂. Type: ANSP 1804.

Thaumapus mirandus (Cresson), new combination

Smicra miranda Cresson, 1872, Trans. Amer. Entomol. Soc. 4:49, ♀, ♂. Type: ANSP 1813.

Spilochalcis montezuma (Cresson), new combination

Smicra montezuma Cresson, 1872, Trans. Amer. Entomol. Soc. 4:51, ♂. Type: ANSP 1819. *Spilochalcis*, *nigricornis* species group.

Spilochalcis nigromaculata (Cameron), new combination

Smicra nigromaculata Cameron, 1884, Biol. Cent.-Amer., Hym., v. 1, p. 83, ♀, ♂. Type: BM 5.197. *Spilochalcis*, *femorata* species group.

Spilochalcis obtusiventris (Cameron), new combination

Smicra obtusiventris Cameron, 1884, Biol. Cent.-Amer., Hym., v. 1, p. 93, ♀, ♂. Type: BM 5.207. *Spilochalcis*, *femorata* species group.

Metadontia octodentata (Cameron), new combination

Smicra octodentata Cameron, 1884, Biol. Cent.-Amer., Hym., v. 1, p. 82.

Type: BM 5.230. Type badly broken, but appears to be *Metadontia*.

Smicra pompiloides Walker

Smicra pompiloides Walker, 1871, Notes on Chalc., p. 53, ♂. Type: Supposed to be in MHNP, but could not be located; not in BM. Probably *Thaumapus*.

Spilochalcis pylas (Walker), new combination

Smiera pylas Walker, 1842, Entomologist for 1842, p. 337, ♀. Type: BM 5.482. *Spilochalcis*, *xanthostigma* species group. This species may be from Brazil rather than from Mexico.

Spilochalcis sexdentata (Cameron), new combination

Smicra sexdentata Cameron, 1884, Biol. Cent.-Amer., Hym., v. 1, p. 81, ♀. Type: BM 5.234. Type in very poor condition. *Spilochalcis*, *sexdentata* species group.

Spilochalcis sicheli (Cameron), new combination

Comura scutellaris Sichel, 1865, Ann. Soc. Entomol. de France (Ser. 4) 5: 359, 388, ♀. Preoccupied.

Smicra sicheli Cameron, 1884, Biol. Cent.-Amer., Hym., v. 1, p. 82. N. name. Type: MHNP. A synonym of *Spilochalcis dux* (Walker). NEW SYNONYMY.

Spilochalcis tenebrosa (Walker), new combination

Smiera tenebrosa Walker, 1861, J. Entomol. 1:181, ♂. Type: BM 5.454. *Spilochalcis*, *xanthostigma* species group.

Spilochalcis tolteca (Cresson), new combination

Smicra tolteca Cresson, 1872, Trans. Amer. Entomol. Soc. 4:42, ♀. Type: ANSP 1822. *Spilochalcis*, *femorata* species group.

Spilochalcis toluca (Cresson), new combination

Smicra toluca Cresson, 1872, Trans. Amer. Entomol. Soc. 4:42, ♀. Type: ANSP 1803. *Spilochalcis*, *toluca* species group.

Key to Mexican Species

1. Female; ovipositor visible on venter of gaster; antennal scape slender 2
 - Male; apical gastral sternite flattened and with a median, apical indentation; antennal scape broadened 8
2. Basal tooth of hind femur much larger than following teeth, Figs. 6, 7; petiole mostly or entirely yellow; malar suture obsolete 3
 - Basal tooth of hind femur little if any larger than following teeth, Fig. 4; malar suture mostly or completely present 5
3. Thoracic dorsum completely black; petiole short, only $1\frac{1}{4}\times$ as long as wide; width of malar space $\frac{2}{3}$ height of compound eye *megalomis* Burks
 - Thoracic dorsum black with yellow spots or cross stripes; petiole longer, 2 to $2\frac{1}{2}\times$ as long as wide; width of malar space $\frac{1}{2}$ height of compound eye 4
4. Scutellum with a median, longitudinal depression; apical scutellar lamina depressed on meson *divisa* (Walker)
 - Scutellum not mesally depressed; apical scutellar lamina not depressed on meson *lasia* Burks
5. Hind femur lacking inner tooth; frons entirely black *nodis*, new species
 - Hind femur with a distinct inner tooth; frons black with yellow spots or entirely reddish brown 6
6. Petiole almost entirely smooth, with only inconspicuous reticulations near base; dorsum of thorax reddish brown *barbara* (Cresson)
 - Petiole with strong, rugose, longitudinal carinae; dorsum of thorax black 7
7. Malar suture extending straight ventrad from compound eye for $\frac{2}{3}$ its length, then curving obliquely toward base of mandible; width of malar space $\frac{1}{2}$ height of compound eye *neptis* Burks
 - Malar suture extending straight from compound eye to base of mandible; width of malar space $\frac{1}{3}$ height of compound eye *colpotis*, new species
8. Malar suture obsolete 9
 - Malar suture present, distinct 11
9. Body densely covered with conspicuous, long setae; basal gastral tergum with a dorsal yellow spot *lasia* Burks
 - Body less densely covered with shorter setae; gaster lacking a dorsal yellow spot 10
10. Hind femur narrow, with widely spaced, triangular teeth, Fig. 8; petiole $4\times$ as long as wide *celis*, new species
 - Hind femur more globose, with teeth slender and more closely set, Fig. 5; petiole $3\times$ as long as wide *divisa* (Walker)

11. Petiole smooth, occasionally with faint striae near base
barbara (Cresson)
 - Petiole with strong, rugose, longitudinal carinae 12
12. Hind femur lacking inner tooth; fore tarsal claw with 8 teeth on basal enlargement *nodis*, new species
 - Hind femur with an inner tooth; fore tarsal claw with 3 teeth on basal enlargement *neptis* Burks

Chalcis megalomis Burks

Chalcis megalomis Burks, 1940, Proc. US Natl. Mus. 88:250, ♀.

Female.—5.0–8.0 mm. Head and thorax black, with 2 spots on parascrobal spaces of head, base and $\frac{2}{3}$ of ventral margin of hind femur, and petiole, yellow; apices of fore and middle femora, inner surface of fore and middle tibiae, all tarsi, wings, and gaster tan or brown. Antennae inserted slightly ventrad of center of frons, apical $\frac{1}{4}$ of scape projecting above level of vertex; width of malar space $\frac{2}{3}$ height of compound eye, malar suture wanting; left mandible with 1 large, acute dorsal tooth and 1 blunt ventral tooth (worn mandibles may appear almost edentate), right mandible with 3 nearly equal, rounded teeth; diameter of lateral ocellus $\frac{1}{3}$ length of ocellular line. Anterolateral angle of pronotum strongly produced, carinate; prepectus concealed; scutellum not flattened and lacking a median, longitudinal depression; hind femur relatively broad, ventral margin with basal tooth large and long, and with 8 to 10 following, small teeth; apex of hind tibia not quite reaching trochanter when tibia is folded against femur. Propodeum with rugose, irregular carinae, a pair of median, slightly irregular, longitudinal carinae in basal $\frac{1}{2}$; petiole smooth and unsculptured, its length $1\frac{1}{2}\times$ as great as its width; gaster slightly shorter than hind femur; apex of hypopygium projecting, isolated from 8th tergum.

Male.—Unknown.

Distribution.—Michigan, Illinois, Iowa, Wyoming, Colorado, Oregon; Mexico. *Mexican Distribution*.—Sonora.

Host.—*Stratiomys* sp.

Type.—Illinois Natural History Survey, Urbana, Illinois.

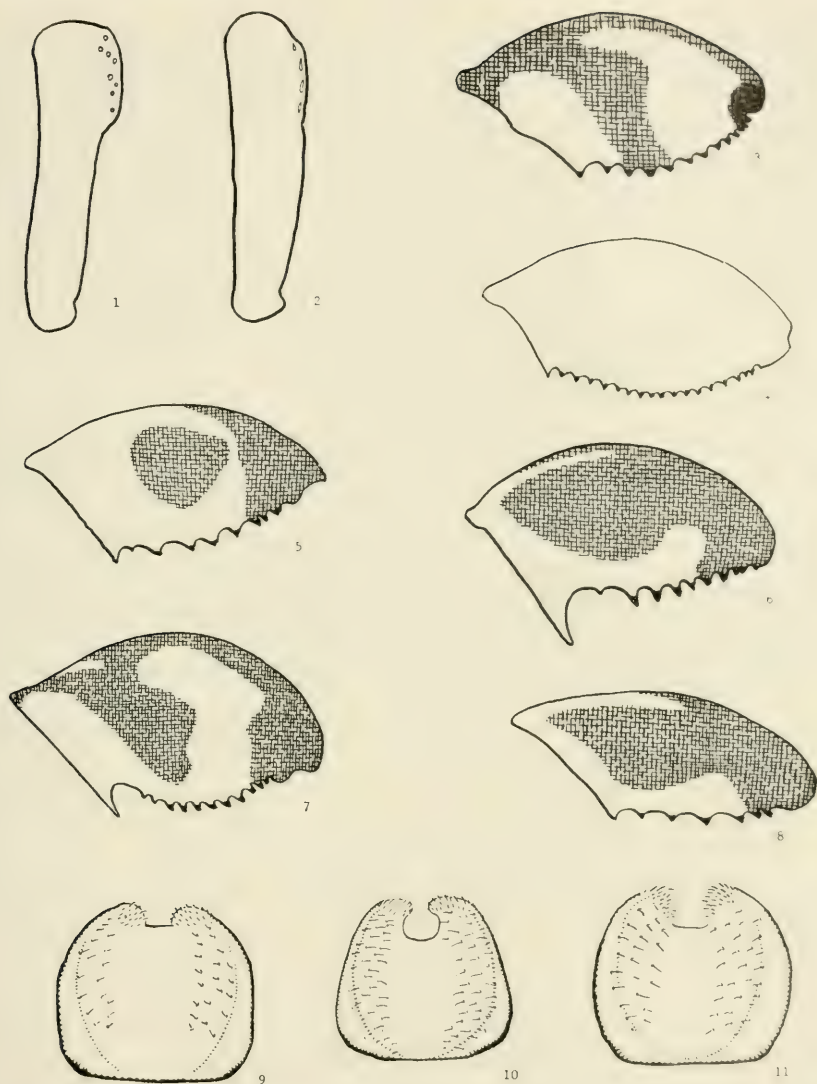
Chalcis divisa (Walker)

(Figs. 5, 6, 10)

Smiera divisa Walker, 1861, J. Entomol. 1:178, ♀, ♂.

Chalcis divisa (Walker) Burks, 1940, Proc. US Natl. Mus. 88:246; Daly, 1963, Ann. Entomol. Soc. Amer. 56:303 (morphology).

Female.—7.0–8.0 mm. Black with yellow markings; parascrobal spaces and interantennal triangle, posterior margin of pronotum, apices of fore



Figs. 1-2. Male antennal scape. 1, *Chalcis nodis*. 2, *C. celis*. Figs. 3-8. Hind femur. 3, *C. nodis*, female. 4, *C. barbara*, female. 5, *C. divisa*, male. 6, *C. divisa*, female. 7, *C. lasia*, female. 8, *C. celis*, male. Figs. 9-11. Male apical gastral sternite. 9, *C. nodis*. 10, *C. divisa*. 11, *C. celis*.

and middle femora, bases of fore and middle tibiae, base and angled dorsal and ventral stripes on outer surface of hind femur, large vertical stripe near apex of inner face of hind femur, spot near base of hind tibia, apex of scutellum, and petiole, yellow. Antennae inserted slightly ventrad of center of frons, scape long, its apex exceeding level of vertex by $\frac{1}{3}$ its length;

width of malar space $\frac{3}{5}$ height of compound eye; malar suture obsolete; each mandible with 3 teeth; posterior carina of gena extending from base of mandible to middle of compound eye; diameter of lateral ocellus $\frac{1}{2}$ length of ocellular line. Anterolateral angle of pronotum strongly produced, carinate; prepectus concealed; scutellum flattened and with a vaguely defined, longitudinal, median depression; hind femur relatively broad, ventral margin with a large and long basal tooth and 6 to 10 small following teeth, Fig. 6; apex of hind tibia extending to trochanter when tibia is folded against femur. Propodeum coarsely carinate, with a median, longitudinal carina in basal $\frac{1}{2}$; petiole smooth, unsculptured, its length 2 to $2\frac{1}{2} \times$ its width; gaster slightly shorter than hind femur; apex of hypopygium projecting, isolated from 8th tergum.

Male.—6.5–8.0 mm. Black with more extensive yellow markings than in ♀; entire frons except for small, triangular area just dorsal to clypeus, all of dorsal surface of pronotum except for narrow space at anterior margin, tegulae, posterior $\frac{2}{3}$ of scutellum, almost entire inner surfaces of fore and middle femora and tibiae, broad basal, dorsal, and ventral areas of outer surface of hind femur, and petiole, yellow. Antennal scape broadened from base to apex, the apex barely exceeding level of vertex; width of malar space $\frac{1}{2}$ height of compound eye. Anterolateral angle of pronotum less strongly produced than in ♀; ventral margin of hind femur lacking an enlarged basal tooth, 7 to 10 small, relatively inconspicuous teeth present, Fig. 5. Gaster slightly longer than hind femur; apical gastral sternite shallowly excavated at hind margin, Fig. 10.

Distribution.—Kansas, Oklahoma, Texas, Arizona, Oregon, California; Mexico. *Mexican Distribution*.—Matamoros, Coahuila; Hermosillo, Sonora; San Jose del Cabo, Baja California Sur; Culiacan, Sinaloa; Cuernavaca, Morelos; Petlalcingo, Puebla; Totolapan, Oaxaca; Matias Romero, Oaxaca; Orizaba, Veracruz.

Type.—BM 5.464.

Chalcis lasia Burks

Chalcis lasia Burks, 1940, Proc. US Natl. Mus. 88:28, ♀, ♂.

Female.—6.0–8.0 mm. Black, with large spots on parascrobal areas of head, a pair of lateral, triangular spots on pronotum, tegulae, a pair of small lateral spots on praescutum, a pair of submarginal, apical spots on scutellum, apices of fore and middle femora, bases of fore and middle tibiae, fore and middle tarsi, wide basal and median areas on outer face of hind femur, subapical area on inner face of hind femur, subbasal spot on hind tibia, and petiole, yellow; all tarsi tan, with apical segment usually slightly darker. Head, body and appendages densely covered with silver colored pubescence. Antennae inserted slightly ventral to center of frons, apex of scape barely exceeding level of vertex; width of malar space $\frac{1}{2}$ height

of compound eye; malar furrow wanting; left mandible with 2 blunt teeth, right mandible with an acute dorsal tooth and 2 ventral, blunt teeth; diameter of posterior ocellus $\frac{1}{2}$ length of ocellocular line. Anterolateral angle of pronotum not projecting, covered with dense hair; prepectus concealed; scutellum subflattened, lacking median, longitudinal depression; hind femur relatively broad, ventral margin with basal tooth long and large, 11 to 14 minute, triangular following teeth present, Fig. 7; apex of hind tibia projecting over trochanter when tibia is folded against femur. Propodeum with rugose, carinate sculpture, a median longitudinal carina present in basal $\frac{1}{2}$ of propodeum, this bifurcating toward apex; petiole very faintly sculptured, its surface not quite smooth, petiole $1\frac{1}{2}\times$ as long as wide; gaster slightly shorter than hind femur; apex of hypopygium projecting, isolated from 8th tergum.

Male.—7.0 mm. Fore and middle legs entirely yellow except for small areas at bases of femora, yellow areas on hind femora and tibiae more extensive than in ♀; gaster with a dorsal yellow spot in middle of 1st gastral tergum. Antennal scape broadened from base to apex, $\frac{1}{4}$ its length projecting above level of vertex; width of malar space $\frac{1}{2}$ height of compound eye. Basal tooth of hind femur not larger than following teeth. Petiole longer and more slender than in ♀, its length $3\times$ its width; gaster and hind femur equal in length; apical gastral sternum shallowly excavated on meson of posterior margin.

Distribution.—Arizona, California; Mexico. *Mexican Distribution*.—Baja California Norte.

Type.—USNM 54365.

Chalcis nodis Burks, new species
(Figs. 1, 3, 9)

This species is similar to *Chalcis flebilis* (Cresson), a common species in the northeastern United States and southeastern Canada. Both have the ovipositor conspicuously exerted, the hind femur lacks an inner tooth, and the male antennal scape is spatulate at the apex, Fig. 1. They differ in that *nodis* has the malar suture incomplete, the female petiole has more rugose sculpture, the male middle tibial spur is lacking, and the posterior margin of the male apical gastral sternum has a shallow median indentation, rather than having a narrow and deep one.

Female.—5.0 mm. Black; tegulae yellow and yellow spots at dorsolateral areas of pronotum, on lateral margins of praescutum near posterior margin, at posterolateral areas of scutellum, near apices of fore femur and middle femur, on apical $\frac{1}{2}$ and basal $\frac{1}{3}$ of outer face of hind femur, and near base of hind tibia; metepisternum, lateral areas of propodeum, and base of gaster red brown. Wings with membrane mostly hyaline, with dense, brown trichiae, and forewing with vague brown shading at posterior margin of marginal vein, around stigmal vein, and on paths of obsolete veins M and

Cu. Pubescence silvery. Antenna inserted slightly ventral to center of frons, antennal scape exceeding by $\frac{1}{6}$ its length level of posterior ocelli; ring segment $\frac{1}{2}$ as long as pedicel, 1st funicular $2\times$ as long as pedicel, 7th funicular $1\frac{1}{4}\times$ as long as pedicel, club as long as 1st funicular; interantennal projection with strong vertical carinae, median carina continued into scrobe cavity; width of malar space $\frac{2}{3}$ as great as height of compound eye, malar furrow straight, extending half-way to mouth opening; right mandible with 1 large, semi-acute dorsal tooth and 2 shorter, blunt ventral teeth, all 3 teeth equal in width at the base; left mandible with 1 large, semi-acute dorsal tooth and 1 truncate ventral tooth, dorsal tooth the wider at base; diameter of posterior ocellus $\frac{2}{3}$ ocellocular distance. Dorsum of thorax with short, decumbent, relatively obscure pubescence; more dense, longer pubescence present at posterolateral angles of pronotum; notaulices distinct throughout; praescutum with irregular, coalescing punctures; prepectus minute, barely visible at margin of pronotum; middle tibial spur wanting; hind femur lacking inner tooth, outer ventral margin with 13 to 15 minute teeth of equal size, Fig. 3; hind tarsal claw elongate, basal enlargement with 3 long, slender teeth. Propodeum conspicuously carinate, a short, longitudinal carina present on meson; petiole $2\times$ as long as wide, dorsal surface sculptured with vague, longitudinal carinae; gaster sparsely setose, its length equal to hind femur; cerci oval, located near posterior margin of 7th gastral tergum; hypopygium exerted, its apex isolated from 6th gastral tergum.

Male.—Dorsum of thorax entirely black, metepisternum and propodeum also black; color otherwise as in ♀. Antennal scape spatulate at apex, Fig. 1; funiculus and club narrower and more elongate than in ♀, ring segment $\frac{1}{3}$ as long as pedicel, 1st funicular $3\times$ as long as pedicel, 7th funicular $2\frac{1}{2}\times$ as long as pedicel, club $3\times$ as long as 1st funicular; width of malar space $\frac{1}{2}$ as great as height of compound eye. Fore tarsal claw with a dense comb of 8 bristles on basal enlargement. Petiole $2\times$ as long as wide, less coarsely sculptured than in ♀; gaster $\frac{1}{2}$ as long as hind femur; apical gastral sternite shallowly incised at apex, Fig. 9.

Described from 4 female, 1 male specimens. *Holotype*, ♀, USNM no. 73685, Mazatlan, Sinaloa, Mexico, collected August 15–20, 1962, H. E. Evans; 1 paratype ♀, same data; 1 paratype ♂, Veracruz, Mexico, July 1959, N. L. H. Krauss; 2 paratype ♀♀, Manzanillo, Colima, Mexico, July 31, 1922, C. H. Ballou. All specimens in USNM Collection.

Chalcis barbara (Cresson)
(Fig. 4)

Smicra rufofemorata Cresson, 1872, Trans. Amer. Entomol. Soc. 4:36, 39, ♂. Preoccupied.

Smicra barbara Cresson, 1872, Trans. Amer. Entomol. Soc. 4:37, 47. "♂"
= ♀.

Chalcis barbara (Cresson) Burks, 1940, Proc. US Natl. Mus. 88:255.

Smicra armillata Cameron, 1897, Ann. Mag. Nat. Hist. (Ser. 6) 19:264. ♂.
NEW SYNONYMY.

Female.—5.0–8.0 mm. Light reddish brown, with antennal flagellum, mandibular teeth, and apex of ovipositor usually dark brown to black; venter of thorax, hind femora and tibiae, propodeum, and basal $\frac{1}{2}$ of petiole sometimes dark brown. Antennae inserted slightly ventrad of center of frons, apex of scape barely exceeding level of vertex; width of malar space $\frac{2}{3}$ height of compound eye; malar suture extending straight ventrad from compound eye for $\frac{1}{2}$ its length and then curving toward mandible; left mandible with 1 large dorsal tooth and 1 minute ventral tooth, right mandible with 3 blunt teeth; diameter of posterior ocellus $\frac{1}{2}$ length of ocellocular line. Anterolateral angle of pronotum with a minute, rounded projection; prepectus minute but visible at margin of pronotum; scutellum rounded, not depressed on meson; hind femur with a sharp inner tooth, outer ventral margin with 16–20 minute, equal-sized teeth, Fig. 4; apex of hind tibia not reaching trochanter when tibia is folded against femur. Propodeum with median, apical and lateral irregular, carinate reticulations, 2 large basolateral areas almost smooth; petiole 2× as long as wide, surface almost smooth, faint reticulations at base and a pair of laterodorsal, longitudinal carinae present; gaster and hind femur equal in length; apex of hypopygium exerted, isolated from 8th tergum.

Male.—5.0–7.0 mm. Black, with fore and hind femora, all tarsi, and basal $\frac{1}{2}$ of gaster reddish brown. Antennal scape enlarged from base to apex, $\frac{1}{4}$ its length extending above level of vertex; width of malar space $\frac{1}{2}$ height of compound eye; diameter of lateral ocellus $\frac{2}{3}$ length of ocellocular line. Gaster slightly shorter than hind femur; apical gastral sternite with posterior margin broadly and shallowly excavated on meson.

Distribution.—New Hampshire, New Jersey, Florida, Michigan, Illinois, Minnesota, Iowa, Missouri, Arkansas, North Dakota, Kansas, Texas, Wyoming, Colorado; Mexico. *Mexican Distribution*.—Taken in aircraft from Mexico at Quarantine Stations at Brownsville and Laredo, Texas; Pte. de Ixtla, Morelos; Cuernavaca, Morelos; Rosario, Sinaloa; El Bonito 11 km south of Ciudad Vailles, San Luis Potosi.

Host.—*Odontomyia* sp.

Type.—ANSP 1790.

Chalcis neptis Burks

Chalcis neptis Burks, 1940, Proc. US Natl. Mus. 88:251, ♀, ♂.

Female.—5.0–6.0 mm. Black, with a pair of spots on parascrobal spaces on head, apices of fore and middle femora, bases of fore and middle tibiae, and an oblique stripe near base of hind femur, yellow; apex on outer face of hind femur and almost entire inner face of hind femur, brown. Antennae inserted slightly ventrad of center of frons, scape with its apex just reaching level of vertex; width of malar space $\frac{1}{2}$ height of compound eye; malar furrow present, straight for dorsal $\frac{2}{3}$ its length, then recurved obliquely toward mandibular base; left mandible with 1 large, blunt, dorsal tooth and 1 smaller, blunt, ventral tooth, right mandible with 1 acute, dorsal tooth and 2 blunt, ventral teeth; diameter of posterior ocellus $\frac{2}{3}$ length of ocellocular line. Anterolateral angle of pronotum projecting, toothlike; prepectus concealed; praescutum with a median, longitudinal depression, this extending onto scutellum as a more vague longitudinal depression; hind femur relatively broad, outer ventral margin with 14 to 16 small teeth, basal tooth slightly the larger; apex of hind tibia extending only $\frac{3}{4}$ the distance from base of femur to trochanter when tibia is folded against the femur. Propodeum covered with coarse, rugulose carinae, a somewhat irregular median, longitudinal carina in basal $\frac{1}{2}$ of propodeum; petiole with very strong, longitudinal carinae, length of petiole $2\frac{1}{4}$ to $2\frac{1}{2}\times$ as great as its width; gaster and hind femur equal in length; apex of hypopygium projecting, isolated from 8th tergum.

Male.—5.5–6.0 mm. Inner face of fore and middle femora and tibiae and basal, dorsal, and subapical stripes on outer face of hind femur yellow. Antennal scape broadened from near base to apex, the apex not quite reaching level of vertex; width of malar space $\frac{1}{4}$ height of compound eye; diameter of posterior ocellus equal to length of ocellocular line. Lengths of gaster and hind femur equal; apical sternite of gaster with a small median, apical notch.

Distribution.—Nebraska, Idaho, Colorado, New Mexico, Utah, Arizona, Washington, Oregon, California; Mexico. *Mexican Distribution*.—Sonora; Durango.

Type.—USNM 54366.

Chalcis colpotis Burks, new species

This species agrees with *Chalcis neptis* Burks in having a rugose petiole, 2 yellow spots on the frons, the head otherwise entirely black, the thoracic dorsum entirely black, the praescutum with a longitudinal, median depression, and the posterior femur with a sharp, well-defined inner tooth. They differ in that *colpotis* has the malar suture straight rather than angled in

the middle, the petiole is shorter and broader, and the width of the malar space is $\frac{1}{3}$, rather than $\frac{1}{2}$, as great as the height of the compound eye.

Female.—5.0 mm. Black with yellow spots; yellow markings at margins of compound eyes on parascrobal spaces of frons, at apices of fore and middle femora, at bases of fore and middle tibiae, and near apex of hind femur; base of outer side and entire inner face of hind femur tan; middle of outer face of hind femur brown. Wings faintly shaded with brown, darker brown on paths of obsolete veins Rs, M, and Cu. Pubescence silvery. Antennae inserted slightly ventral to center of frons, apex of antennal scape barely exceeding level of posterior ocelli; ring segment $\frac{1}{2}$ as long as pedicel, 1st funicular $2\times$ as long as pedicel, 7th funicular as long as pedicel, club as long as 1st funicular; interantennal projection with a median vertical carina, this continued into scrobe cavity and extending to anterior ocellus; width of malar space $\frac{1}{3}$ as great as height of compound eye, malar furrow straight, extending from eye to mouth opening; right mandible with 1 large, semi-acute dorsal tooth and 2 smaller, blunt ventral teeth; left mandible with 1 large, semi-acute dorsal tooth and 1 short, blunt ventral tooth; diameter of posterior ocellus $\frac{2}{3}$ ocellocular distance. Dorsum of thorax with relatively long, dense pubescence; notaulices distinct throughout and strongly depressed below level of dorsum; praescutum with a median, longitudinal depression; prepectus not visible; middle tibial spur absent; hind femur with sharp, well-defined inner tooth, outer ventral margin with 15 minute, closely set teeth, median teeth slightly the larger; hind tarsal claw elongate, basal enlargement with 3 minute, triangular teeth. Propodeum roughly carinate, an irregular median pit near dorsal margin, this usually with a median, vertical carina; petiole with irregular, longitudinal rugae, length of petiole $1\frac{1}{4}\times$ its width; gaster laterally densely setose on 2nd to apical segments; cerci oval, located near posterior margin of 7th tergum; hypopygium exerted, its apex isolated from 8th gastral tergum.

Male.—Unknown.

Described from 7 specimens. *Holotype*, ♀, USNM no. 73686, Yuriria, 1,980 m elev., Guanajuato, Mexico, August 7, 1962, H. E. Evans; 3 paratype ♀♀, same data; 1 paratype ♀, 33 km north of Acambaro, 2,310 m elev., Guanajuato, Mexico, H. E. Evans; 1 paratype ♀, 8 km east of Durango, Durango, Mexico, August 3, 1952, J. D. Lattin; 1 paratype ♀, Mexico, collection W. M. Giffard, 459. Specimens in USNM and California Academy of Sciences.

Chalcis celis Burks, new species
(Figs. 2, 8, 11)

This species agrees with *divisa* (Walker) in lacking a malar carina, in lacking an inner tooth on the hind femur, in having yellow spots on the

frons of the head and at the apex of the scutellum, and in having the petiole almost entirely yellow; they differ in that *celis* has a longer, more slender petiole, the hind femur is narrower (Figs. 5, 8) and has fewer, more widely spaced teeth.

Female.—Unknown.

Male.—7.0 mm. Black, with yellow and tan markings; lateral areas of frons and interantennal projection, posterior dorsal margin of pronotum, tegulae, large posterolateral spots on scutellum, inner surface of fore tibia, dorsal stripe on basal $\frac{1}{2}$ of hind femur, outer basal and ventral areas of hind femur, large apical spot on inner face of hind femur, basal $\frac{1}{3}$ of hind tibia, and all of petiole except ventrobasal $\frac{1}{3}$, yellow; apical halves of inner surface of fore and middle femora, tan; wings yellowish tan, forewing slightly darkened below marginal vein, around stigmal vein, and along paths of obsolete veins M and Cu. Antennae inserted in center of frons, scape enlarged from base to apex, Fig. 2, and $\frac{1}{3}$ its length projecting above level of posterior ocelli; pedicel $2\times$ as long as ring segment, 1st funicular segment $3\frac{1}{2}\times$ as long as pedicel, 7th funicular $\frac{5}{6}$ as long as 1st, club $1\frac{1}{2}\times$ as long as 1st funicular; interantennal projection umbilicate, with faint carina at apex only; width of malar space $\frac{1}{2}$ height of compound eye; malar furrow obsolete. Anterolateral angles of pronotum produced, carinate; pubescence dense, long; prepectus concealed; apex of scutellum depressed on meson; hind femur relatively narrow and outer ventral margin with 7 small, widely spaced teeth, Fig. 8; inner tooth absent; apex of hind tibia reaching trochanter when the tibia is folded against the femur. Propodeum coarsely and irregularly carinate, a prominent median, longitudinal carina present; petiole smooth, unsculptured, broader at apex than at base, its length $4\times$ its maximum width; gaster as long as hind femur, gastral segments 2 to 7 moderately setose; apical gastral sternite with a quadrate, median excavation at apex, Fig. 11.

Described from 1 specimen. *Holotype*, ♂, San Cristobal de las Casas, 2,160 m elev., Chiapas, Mexico, August 3, 1966, D. E. Breedlove and J. Emmet. Deposited in California Academy of Sciences.

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POPULATION DYNAMICS OF PROTELEAN PARASITES
(HYMENOPTERA: APHELINIDAE) ATTACKING A NATURAL
POPULATION OF *TRIALEURODES PACKARDI* (HOMOPTERA:
ALEYRODIDAE) AND NEW HOST RECORDS
FOR TWO SPECIES¹

Nancy T. Kuenzel

Abstract.—The natural population interactions of a complex of aphelinid parasites with the host *Trialeurodes packardii* (Morrill) were studied for two growing seasons. New host records were established for *Encarsia pergandiella* Howard and *E. quaintancei* Howard. Parasites were a significant mortality factor for the whitefly population, and *Encarsia pergandiella* dominated the parasite complex numerically. Male *E. pergandiella*, hyperparasites of female *Encarsia*, increased dramatically in numbers at the end of the growing season.

The population biology and dynamics of some parasitic Hymenoptera attacking aleyrodids have been studied under controlled conditions (Burnett, 1949, 1958, 1960, 1962; Gerling, 1966a, 1966b; Helgesen and Tauber, 1974), and the composition of a species complex parasitizing one naturally-occurring aleyrodid population has been reported (Dysart, 1966). However, no information is available concerning the population dynamics of an intact parasite complex supported by a natural aleyrodid population. This communication describes the population dynamics of the constituents of a chalcidoid complex parasitizing a naturally-occurring population of the strawberry whitefly, *Trialeurodes packardii* (Morrill), on a preferred host plant, jewelweed, *Impatiens pallida* Nuttall (Kuenzel, 1975) and reports new host records for two parasite species.

Methods

The study area was located on the north bank of Beebe Lake, Ithaca, New York. The population of the host, *Trialeurodes packardii*, and surface area of *Impatiens* leaves available to whiteflies were sampled at weekly intervals of the growing season in 1972 and 1973 until demise of the plants in the fall. The leaf was employed as the sampling unit. Leaves were collected by the regime described by Kuenzel (1975) and were refrigerated at 2°C until insects could be counted. A stereomicroscope was employed in enumeration, and numbers per leaf of each immature whitefly stadium and parasitized larva were noted. Parasitism was first apparent in fourth-instar whiteflies using this technique. Numbers per leaf were divided by leaf surface area, and a mean density of unparasitized and parasitized white-

fly larvae was computed for each weekly sample. These means were multiplied by the mean surface area of *Impatiens* plants for that week to give an estimate of mean number of insects per mean plant in each collection. In 1973, each parasitized whitefly and a small section of the leaf were cut from the rest of the leaf with a cork borer. Each parasitized larva was incubated individually in a gelatin capsule at 25°C, and the emergent parasite was preserved in 75% ethanol for identification. After obviously parasitized larvae were removed from the leaf, the remainder of the leaf was incubated at 25°C on moistened filter paper in a covered petri dish to determine if any whiteflies were parasitized that had not appeared so at time of counting. Counts of fourth-instar whiteflies were corrected for any parasitism appearing after incubation.

To estimate the absolute numbers per plant of each species and sex of parasite larva in 1973, proportions of each sex and species emerging from the gelatin capsules for each weekly collection were multiplied by the mean number of parasitized whiteflies per plant for that collection. Although a quantitative sample of parasite species was taken only in 1973, some parasite larvae collected in 1971 and 1972 were also reared and preserved for identification.

The estimate of parasitism is conservative because during incubation leaves often began to mold within a few days and thus prohibited development of the whiteflies and their parasites. Even on healthy leaves, it seems likely that experimental conditions and initial cold storage would decrease the number of parasites developing relative to the number successfully maturing in the field. Additionally I assumed that all sexes and species of parasite responded similarly to conditions of incubation in the gelatin capsules.

Results and Discussion

All parasites were aphelinids. In 1971 the following species and sexes were collected: *Encarsia pergandiella* Howard, females; *Encarsia quaintancei* Howard, females; *Encarsia* spp. males; and *Eretmocerus corni* Haldeman, one male and one female. In 1972 and 1973 both sexes of *Encarsia pergandiella* and *E. corni* were collected, but *E. quaintancei* was absent. The males classified as *E. pergandiella* in 1973 could not be definitely confirmed as that species because they appeared quite similar to *E. quaintancei*. It is likely that they were *E. pergandiella*, however, since no female *E. quaintancei* were collected in 1973. Furthermore, males of *E. pergandiella* are hyperparasitic upon *Encarsia* females (Gerling, 1966a), and a hyperparasitized larva can be detected because the remains of the primary parasite are visible as a dark spot through the whitefly pupal case when the hyperparasite reaches the prepupal stage. Half of the

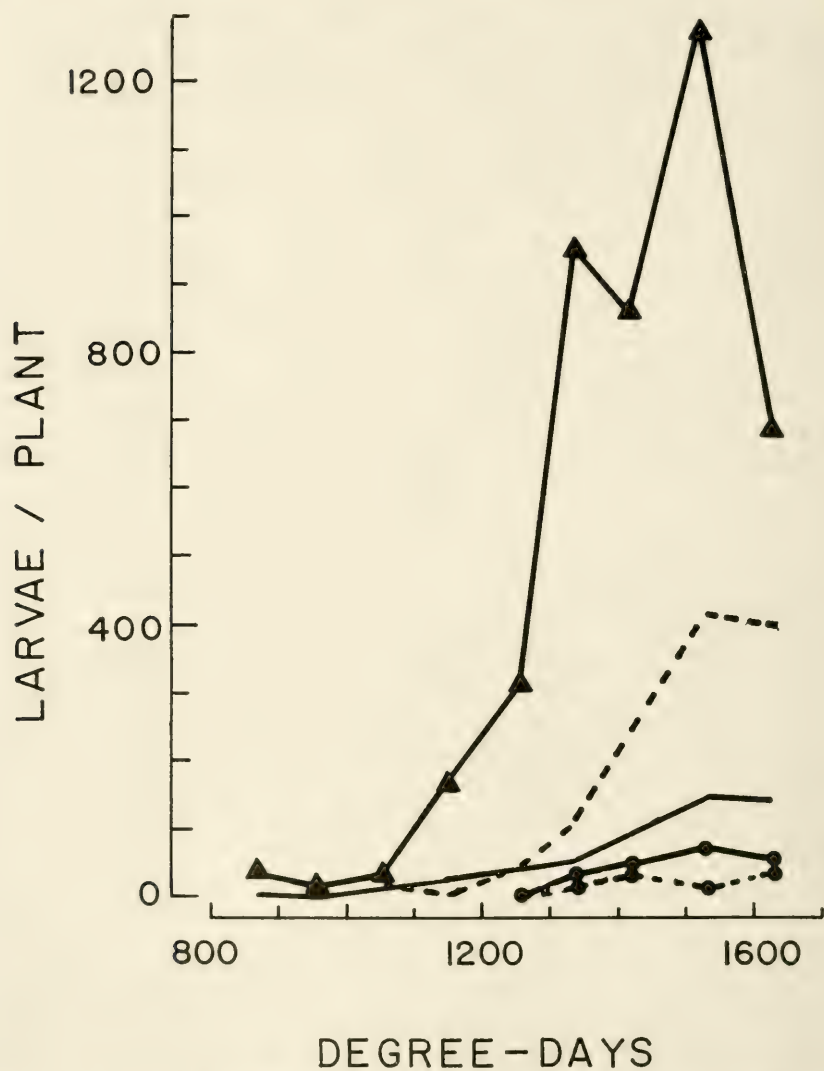


Fig. 1. Number of *Trialeurodes packardii* fourth-instar larvae per *Impatiens* plant parasitized by *Encarsia pergandiella* males (---), *E. pergandiella* females (—), *Eretmocerus corni* males (-●-) and *E. corni* females (-●-) compared to the number per plant of unparasitized *Trialeurodes packardii* fourth instars (Δ). The chronological scale is in accumulated degree-days ($^{\circ}\text{C}$ above 8°).

whitefly pupal cases producing male *Encarsia* specimens sent for determination distinctly exhibited this characteristic.

Trialeurodes packardi has not previously been reported as a host for *Encarsia pergandiella*. Other known hosts are the aleyrodids *Pealius azaleae* (Baker and Moles), *Aleyrodes spiraeoides* Quaintance, *Trialeurodes vaporariorum* (Westwood), *Aleyrodes* spp. (Gerling, 1966a) and *Trialeurodes abutilonea* (Haldeman) (Dysart, 1966). *Trialeurodes packardi* is also a new host record for *Encarsia quaintancei*. Previously reported hosts for this parasite are *Aleyrodes* spp. on *Polygonum* (Peck, 1963) and *Trialeurodes abutilonea* (Dysart, 1966).

Analysis of the quantitative sample of the parasite complex in 1973 is illustrated in Fig. 1 and compared to the number of unparasitized fourth-instar whiteflies. Numbers of insects per plant are considered relative to accumulated degree-days above 8°C, the theoretical developmental zero for *T. packardi* (Kuenzel, 1975). Initial appearances of both *Encarsia pergandiella* and *Eretmocerus corni* were on the same date, 869 degree-days (July 17). However *Encarsia pergandiella* increased in numbers while *Eretmocerus corni* declined, disappeared and was not collected again until 1,336 degree-days (August 21). The total number of *E. corni* per plant never exceeded 100 individuals, and females were more abundant than males. Populations of both sexes of *Encarsia pergandiella* increased exponentially from the time of first appearance to 1,528 degree-days (September 9) when a plateau was reached. This cessation of growth in parasite numbers is probably related to the decline in numbers of available hosts. The sex ratio of *E. pergandiella* oscillated around 50% until 1,416 degree-days (August 28) when a dramatic increase in number of males was observed. The maximum numbers per plant of primary parasites and hyperparasites were 139 and 417, respectively, occurring at 1,528 degree-days.

One objective of this study was to provide data on abundance of parasite species attacking a naturally-occurring whitefly population throughout the growing season in order to complement existing studies of whiteflies and their parasites in controlled situations. This investigation indicates that one species may dominate, throughout the summer, a complex of parasites attacking a natural whitefly population. Similarly, Dysart (1966) found that two species accounted for 86% of all parasites attacking a natural population of *Trialeurodes abutilonea* in one summer and that *Encarsia quaintancei* dominated the complex constituting 63% of the specimens. Therefore it appears that the artificial whitefly communities consisting of single whitefly and parasite populations studied by Burnett (1949, 1958, 1960, 1962) and Helgesen and Tauber (1974) are similar in composition to at least some natural communities.

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Footnote

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THE LARVA OF *PHILONTHUS NUDUS* (SHARP),
A SEASHORE SPECIES FROM WASHINGTON
(COLEOPTERA: STAPHYLINIDAE)

Ian Moore

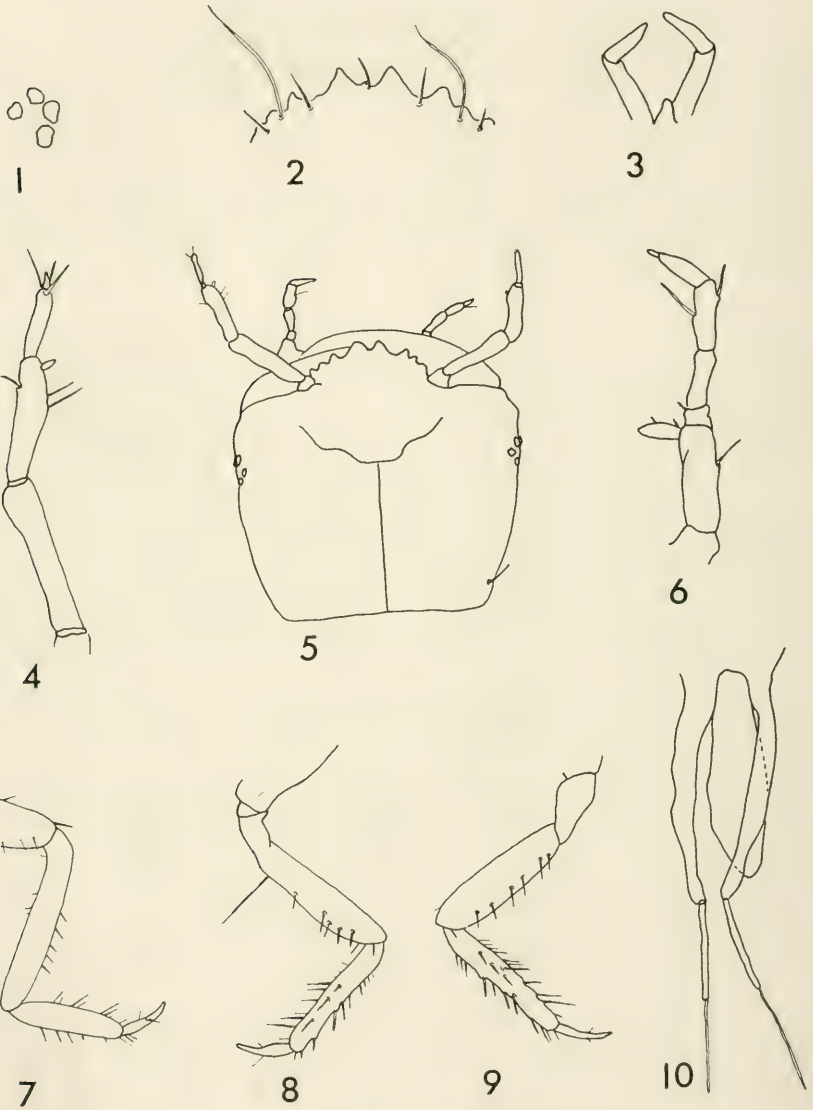
Abstract.—The larva of *Philonthus nudus* Sharp is described and illustrated from a single specimen taken in company with 22 adults on the seabeach of Washington State.

Philonthus nudus (Sharp) is a species of rove beetle which was reported by Hatch (1957) as being very common on the seashore of British Columbia and Washington. It was first described from Japan (Sharp, 1874) in the genus *Cafius*. Fall (1916) described it from North America as a new species, *Cafius johnsoni*. Each of these authors placed it in *Cafius* apparently because of its seashore habitat. The fact that it is a large species and was not discovered in Pacific North America until 1916, but is now very common, indicates that it is probably a recent accidental introduction from Japan. Koch (1936) treated *johnsoni* as a subspecies of *nudus*. Moore (1965) pointed out that the species does not belong in *Cafius*, but in *Philonthus*, and that the character used by Koch to separate *johnsoni* and *nudus* is not valid in a long series of specimens.

The larvae of Staphylinidae are poorly known. The known larvae of North American species constitute only one-third of one percent of the North American fauna (Moore and Legner, 1974). Only six of the 145 described North American species of *Philonthus* (Moore and Legner, 1975a) have had anything recorded about their early stages; and the larvae of only another nine Holarctic *Philonthus* species have been described in the European literature (Moore and Legner, 1974).

The early stages of seashore Staphylinidae are better known than those of other members of the family. In their restricted seashore habitat, it is easier to associate larvae with adults. Special attention has been recently given to this habitat. The fact that the developmental stages of most of the Pacific Coast species of *Cafius* were treated by James, et al. (1971) and Moore and Legner (1975b) has made the association of the present larva with the adult of *Philonthus nudus*, in whose company it was taken, nearly certain.

In his key to the larvae of the Staphylinidae, Paulian (1941) separated the larvae of *Philonthus* and *Cafius* on the character of the urogomphus being shorter than the pseudopod in the former and as long as or longer than the pseudopod in the latter. It is obvious from his illustrations of members of each genus that Paulian was referring to the first segment of



Figs. 1-10. Larva of *Philonthus nudus*. 1, ocelli. 2, anterior margin of clypeus. 3, labium. 4, antenna. 5, head. 6, maxilla. 7, front leg. 8, middle leg. 9, hind leg. 10, pseudopod and urogomphi.

the urogomphus rather than to the entire organ. This character, as so modified, holds true for the larva of *P. nudus* as described here.

Larva of *Philonthus nudus* (Sharp)

Color.—Pale, ferrugineous with the appendages testaceous.

Form.—Elongate, subparallel; head and appendages moderately chitinized, thorax and abdomen very weakly so.

Head.—Trapezoidal, about as wide as long, widest near apex; sides almost straight with posterior angles slightly rounded into neck, base straight. Neck about $\frac{3}{4}$ as wide as head. Surface gently convex, shining with a moderate reticulate depression in the clypeal area. Ocelli 4, arranged in a compact group at the side of the head at about $\frac{1}{4}$ the distance from base of mandible to base of head. Clypeal margin with 9 teeth, middle tooth minute, outer teeth small, other teeth progressively larger. Antennae 4-segmented; 1st segment short; 2nd about as wide as 1st, about $5\times$ as long as wide; 3rd about as wide as 2nd and about $\frac{2}{3}$ as long, with an obliquely placed "acorn seta" near apex which is about as long as width of segment; 4th segment about $\frac{1}{2}$ as wide as 3rd and little more than $\frac{1}{2}$ as long. Maxilla with stipes about $3\times$ as long as wide; galea elongate oval, less than $\frac{1}{2}$ as long as stipes; maxillary palpus 4-segmented, 1st segment not quite as long as wide, 2nd segment about $3\times$ as long as wide, 3rd and 4th segments subequal in length and width to 2nd. Ligula about $\frac{1}{3}$ the length of the 1st segment of the labial palpus. Labial palpus 2-segmented, 1st segment about $3\times$ as long as wide, 2nd segment somewhat narrower and shorter than 1st, bluntly pointed. Gula with 3 widely separated parallel sutures.

Thorax.—Pronotum somewhat shriveled, apparently about as wide as long, widest at apex. Surface shining with a few setae at margins. Mesonotum and metanotum badly shriveled.

Abdomen.—Badly shriveled due to its membranous condition. Pseudopod 3 to $4\times$ as long as wide, shorter than 1st segment of urogomphus. Urogomphus 2-segmented, each segment several times as long as wide; 1st segment a little longer than urogomphus; 2nd segment about as long as and about $\frac{1}{2}$ as wide as 1st, bearing a stout seta at apex which is as long as segment.

Length.—12 mm.

Material Examined.—One specimen, Washington, Kitsap County, Bainbridge Island, 13 October 1974, on beach in company with 22 adults. Derham Giuliani, collector.

Philonthus nudus keys out to *P. distans* Horn in Horn's (1884) key to *Philonthus*. It differs from *P. distans* in that the legs are piceous and the head quadrate whereas in the latter, the legs are testaceous and the head

is oval. The length is 10 mm; that of *P. distans* 5 mm. *Philonthus nudus* differs from all of our Pacific Coast species of *Cafius* in having a series of four strong punctures on each side of the highly polished disc of the pronotum. In our species of *Cafius*, the disc of the pronotum is usually densely punctured and is always dull at least in part.

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THE VALIDITY OF THE GENERIC NAME *PARAMELETUS*
BENGTTSSON (EPHEMEROPTERA: SIPHLONURIDAE)

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Abstract.—The generic name *Parameletus* Bengtsson is shown to be a valid name, with *Sparrea* Esben-Petersen, *Potameis* Bengtsson, *Palmenia* Aro, and *Siphonuiroides* McDunnough as junior synonyms.

There has recently been some confusion concerning the valid name of the genus of mayflies which has generally been known as *Parameletus* Bengtsson. The names *Sparrea* Esben-Petersen and *Potameis* Bengtsson have also been used for this genus. It is my intent to show that *Parameletus* is the valid name for this genus, thereby stabilizing the nomenclature and avoiding future confusion in the literature.

In 1908 (p. 242) Bengtsson described the larvae of *Parameletus chelifer* from Sweden. Although the description is brief ["larven, som är synnerligen utmärkt genom sina till saxklor omvandlade labialpalper": 'the larvae of this species which is very remarkable due to its labial palps which are transformed to scissor-like claws'], it is sufficient to meet the requirements of a description of the International Code of Zoological Nomenclature (Art. 12) and the name *Parameletus chelifer* Bengtsson, 1908 cannot be considered to be a *nomen nudum*. Bengtsson also mentioned this species as *Parameletus affinis* [*nomen nudum*] in 1904 (p. 131).

In 1909 Esben-Petersen (p. 554) established the genus *Sparrea* for the single species *S. norvegica*. Later that same year Bengtsson (p. 13) established *Potameis* for the two species *P. elegans* and *P. minor*. Aro (1910, p. 28) established the genus *Palmenia* for the new species *P. fennica*. Bengtsson (1930, p. 13) showed that *Palmenia*, *Potameis*, and *Sparrea* were synonymous with *Parameletus*. In 1923 McDunnough (p. 48) had established *Siphonuiroides* which he later (1932, p. 81) placed as a synonym of *Parameletus*.

Thus, *Parameletus* Bengtsson, 1908, is the valid name for this genus [type-species: *Parameletus chelifer* Bengtsson, by monotypy] with *Sparrea*, *Potameis*, *Palmenia*, and *Siphonuiroides* all falling as junior synonyms.

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CHARACTERISTICS OF FIELD-COLLECTED POPULATIONS
OF THE GERMAN COCKROACH
(DICTYOPTERA: BLATTELLIDAE)

Mary H. Ross and Charles G. Wright

Abstract.—Age distribution analyses in field-collected populations of *Blattella germanica* (L.) showed low numbers of nymphs in proportion to those expected from the numbers of adult females. Nymphal distribution was generally quite uniform throughout the six instars. It is postulated that oviposition was limited by scarcity of water and/or food.

The German cockroach, *Blattella germanica* (L.), has been studied extensively (Cornwell, 1968; Guthrie and Tindall, 1968). Nevertheless, surprisingly little is known concerning the dynamics of field populations, especially their age structure. The available information is largely confined to estimates of absolute population density (Mallis, 1960; Wright and Hillman, 1975) and the observation that populations tend to peak in late summer to fall months (Wright and McDaniel, 1973). An understanding of the growth and development of natural populations is needed in the effort to reduce the use of insecticides. For example, there may be times at which insecticide applications could be particularly effective. Also, such knowledge is requisite to planning integrated control programs, such as those that might take advantage of genetic control mechanisms currently under development (Ross and Cochran, 1976).

The data reported here are the first detailed analyses of the age structure of field populations. The findings are preliminary. However, they show population structures that are markedly different from those observed in the laboratory. Implications in respect to genetic control are sufficiently significant to warrant following field populations on a year-round basis.

Materials and Methods

The cockroaches were collected from nine single-family dwellings in North Carolina during July–August 1973. An intensive search of each room showed infestations were confined to the kitchens in five houses. None were found in bathrooms. Living rooms and bedrooms yielded small collections and a large infestation occurred in one utility room. Infestations were heavy throughout the room in several kitchens (Table 1: 2K, 7K, 8K and 9K). Others occurred in particular areas, such as on or near a flour cabinet (4K), within dressers (4B, 7B and 8B), near or under sink (1K), within walls (6K, 6L) and on walls and in pantry (5K). Notes were taken as to general sanitary conditions. Collection, using a modified suction

vacuum cleaner (Wright, 1966), was continued until repeated thorough search gave negative results. The insects were preserved in 70% alcohol and sorted into groups of adults and large, medium and small nymphs. Instar determination was made microscopically using either the numbers of cercal segments (Murray, 1967) or doublet groups in the antennae (Campbell and Priestley, 1970). Fifth- and 6th-instar nymphs and adults were sexed as well as counted. No attempt was made to distinguish between the 6th and a possible 7th instar.

The term "productivity" as used herein refers specifically to the number of progeny surviving to the adult stage among those produced per mated parental female (King, 1972).

Results and Discussion

In most cases, there was no significant deviation from the expected 1:1 sex ratio (Table 1, cols. 4-6). A scarcity of nymphal and adult males in two collections, 2K and 7K, suggests the effects of environmental stresses in view of Wharton et al.'s (1967) studies of the American cockroach. In 9U, the collection was largely females, but these were probably attracted to the moisture in the utility room (damp mops, buckets of water) just prior to oviposition. This type of behavior occurs in laboratory colonies (Ross, unpublished). Also, the egg cases were close to maturity.

In general, population density was related directly to the level of sanitation. This was seen in distribution, i.e., prevalence in kitchens vs. scarcity in other rooms, as well as in totals/habitation. Productivity was also related to sanitation (Table 1, col. 11). Large, well-established populations in rooms with poor sanitation showed comparatively high productivities, i.e., adult ♀/nymph ratios of 1:4-1:8 in 6K, 7K, 7L, 8K and 8B (2nd). Three small, poorly established populations, 1K, 4L and 4B, also showed high productivity estimates—an occurrence for which recent migrations or sampling errors are equally plausible explanations. Ratios of 1:1-1:3 were found in populations with fairly large numbers of adults but better levels of sanitation (2K, 3K, 7B and 8B (1st)). Productivities in 9K and 9U lend added support to the proposed female migration noted above. The latter would account for the association of poor sanitation with a very low productivity in 9K and the extremely high productivity in 9U. Considered in their entirety, these data indicate food is a primary extrinsic factor in limiting size and productivity in field populations, but that productivity may be even more severely restricted by water and/or humidity.

The productivities noted above are strikingly low in comparison to ratios such as 1:28 found in laboratory populations that were kept below the carrying capacity of their containers (Ross, 1975, Nov. Census, unpublished). Productivity in the free populations was clearly limited. Over-

Table 1. Analyses of the age structure of field collections of *Blattella germanica*.

House	Room ^a	Total no.	No. adults (♂, ♀)	No. per instar					Ratio adult ♀ : nymphs		Notes on sanitation
				6 (♂, ♀)	5 (♂, ♀)	4	3	2	1		
1	K	23	3 (2,1)	4 (1,3)	4 (2,1)	0	0	0	0	1:8	good
2	K	196	114 (35,79)	32 (13,19)	31 (11,20)	28	27	42	42	1:3	poor
3	K	223	141 (72,69)	28 (18,10)	4 (3,1)	25	9	2	14	1:2	good
4	K	183	74 (32,42)	11 (4,7)	17 (8,9)	27	17	11	26	1:3	avg
4	L	49	11 (4,7)	11 (6,5)	1 (0,1)	7	3	5	11	1:5	
4	B	16	2 (0,2)	1 (1,0)	0	0	1	1	11	1:7	
5	K	426	220 (100,120)	34 (12,22)	26 (7,19)	39	39	25	53	1:2	avg
6	K	521	102 (53,49)	81 (31,50)	61 (33,28)	131	79	49	18	1:8	poor
7	K	685	193 (79,114)	64 (23,41)	39 (17,22)	101	78	126	84	1:4	poor
7	L	167	62 (36,26)	11 (8,3)	19 (10,9)	16	22	15	22	1:4	
7	B	85	53 (23,30)	21 (11,10)	4 (2,2)	5	2	0	0	1:1	
8	K	939	347 (194,153)	11 (10,1)	121 (50,71)	74	63	112	211	1:4	very poor
8	B (1st)	79	59 (41,18)	9 (3,6)	1 (1,0)	1	0	6	3	1:1	
8	B (2nd)	250	67 (30,37)	50 (26,24)	14 (6,8)	30	12	19	58	1:5	
9	K	644	356 (182,174)	96 (49,47)	55 (26,29)	52	33	24	27	1:2	very poor
9	U	1445	114 (13,101)	24 (6,18)	36 (13,23)	93	244	385	549	1:13	

^a Letters indicate sites, i.e., kitchen (K), living room (L), bedroom (B), and utility room (U).

crowding and possibly other factors causing nymphal mortality may reduce productivity in laboratory populations, giving ratios of about 1:8-1:15 (Mele, 1972), but the majority of field populations were even more severely restricted.

Nymphs of all age groups were present in most collections, and the distribution per age group was frequently quite uniform (Table 1, cols. 5-10). There was no consistent tendency for a decrease in numbers with age. This pattern differs markedly from those observed in laboratory populations (Mele, 1972; Ross, 1975). In the former, regulation by density-dependent factors resulted in large numbers of early instar nymphs, very low numbers in late instars, and intermediate numbers of adults. Only 9U and, to a lesser degree, 8K, showed a comparable structure. However, the large numbers of early instar nymphs in 9U and 8K are not necessarily indicative of nymphal mortality, as was the case in the laboratory populations. They could be due to a sudden increase in oviposition and hatch. The other collections showed no evidence of high mortality among young nymphs. Nevertheless, their growth had obviously been limited. It is difficult to account for these findings other than by restriction of reproduction.

Certain physiological characteristics of *B. germanica* lend strength to the above hypothesis. Food is limited in field situations. Roth and Stay (1962) showed that starved females will not mate. Moreover, preovipositional feeding is a requirement for oothecal formation (Kunkel, 1966). Water availability, as shown in 9U, may be equally or more important. In the American cockroach, Mills and Nielsen (1967) noted that water intake must be sufficient for both the body and developing egg. An inadequate supply of water under conditions of low humidity resulted in collapse of egg cases in laboratory cultures of *B. germanica* (Ross, unpublished).

A comparison between the numbers of adult females and unhatched oothecae is shown in Table 2. Sixty percent or more of the females lacked oothecae in all except three collections. In 9U, the large numbers of first-instar nymphs indicate this can be attributed to recent deposition. The other data suggest oothecal formation was inhibited. Periods at which females normally lack oothecae are not sufficient to explain the present data. The most frequent would be following deposition of an ootheca, but this is ruled out by the small numbers of first-instar nymphs. Old females sometimes lack oothecae but they form a very minor portion of a total population. Recent maturation would be evidenced by females lacking full pigmentation; large numbers of the same general age group in the 6th instar, and comparably large groups among preceding nymphal stages. This was not the case. Nevertheless, the oothecae that were present showed no evidence of abnormal development or lethality. It appeared that the pop-

Table 2. Estimates of oothecal production in field collections of *Blattella germanica*.

House	Room ^a	No. adult ♀	No. oothecae (unhatched)	% ♀ with oothecae ^b	Avg. eggs/ootheca
1	K	1	0		
2	K	79	42	53	43.0
3	K	69	27	39	37.4
4	K	42	15	35	37.0
4	L	7	4	57	36.7
4	B	2	0		
5	K	120	47	39	38.3
6	K	49	19	39	39.3
7	K	114	63	55	42.2
7	L	26	3	19	40.8
7	B	30	12	40	44.2
8	K	153	19	12	37.1
8	B (1st)	18	3	17	41.0
8	B (2nd)	37	12	32	40.4
9	K	174	70	40	36.4
9	U	101	39	39	35.1

^a Sites indicated as kitchen (K), living room (L), bedroom (B), and utility room (U).

^b Based on the assumption loose oothecae had become detached from the parental ♀ through handling.

ulations were on the verge of an increase in productivity. Wright and McDaniel (1973) reported a yearly peaking of German cockroach field populations in September, which tends to verify this hypothesis.

Conditions causing house to house variations could only be treated here in a cursory manner without more extensive data. The most important finding is that such variations were minimal in comparison to the differences in productivity and age structure between the field and laboratory populations. Laboratory populations are limited by the size of the container. Overcrowding causes high mortality among small nymphs. We suggest that food and water are primary regulating factors in field populations and that they curb growth by inhibiting oviposition. If this hypothesis is confirmed by further field study, it will have significant implications in respect to genetic and other control measures. From the point of view of genetic control, the consistently small numbers of large nymphs and probability of seasonal variations are also noteworthy.

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COLASPIS CHRYSIS OLIVIER AND ITS CLOSE RELATIVES
(COLEOPTERA: CHRYSOMELIDAE)

Doris H. Blake

Abstract.—Five species of North American *Colaspis* are described and all are very similar in having the same shaped prothorax and aedeagus. Two species occur in the East; the other three in the West, in Oregon, California and Arizona.

The *Colaspis chrysis* group has one characteristic that I have not found in any other of the *Colaspis* species, namely, an unusual prothorax that is long and convex, with rounded sides, and the front of the prothorax almost conceals the head below. The eyes of the head are nearly hidden by the prothorax and are small and far apart. In addition, the aedeagus when viewed from above is broad clear to the end with a minute pointed tip in the middle. This shaped aedeagus is almost identical in all the five species of the group, although differing in length. In fact, the largest species of the group, *C. chrysis*, has the shortest aedeagus. The smallest of the group, *C. cruriflava*, I included in my paper on the *Colaspis favosa* group, although I stated in my description of it that it did not resemble the rest of the *favosa* group in having longer elytra and in being with a differently shaped aedeagus. I had named it *cruriflava* because it was the only one of the group with yellow legs. I ended my description by writing, "In fact it hardly belongs in the group." At the time I had not studied the species of the *chrysis* group and this small species seemed to fit in with the other small green species of the *favosa* group.

Colaspis chrysis (Olivier)
(Fig. 5)

Eumolpus chrysis Olivier, 1808, Entomologie VI, p. 880.

Colaspis chrysis Horn, 1892, Trans. Amer. Entomol. Soc. XIX, p. 223.

Length, 7-9 mm. Width, 3.5-5 mm. Elongate oblong oval, shining green with yellow legs and antennae, densely punctate throughout with transverse ridging across elytra. Head nearly concealed by prothorax, interocular space more than $\frac{1}{2}$ width of head, eyes small; densely punctate even over frontal tubercles, labrum yellow brown, antennae also yellow brown. Prothorax not much wider than long, with sides somewhat curved with very faint trace of toothing below middle in some specimens, convex, densely punctate. Scutellum shining dark green. Elytra scarcely $3\times$ as long as prothorax and wider, densely and finely punctate, punctures in single rows near suture, irregularly geminate elsewhere, punctures not coarse,

traces of longitudinal costae, but strongly transverse ridging across elytra below shoulders. Body beneath densely punctate over prosternum and mesosternum and very finely punctate over abdomen.

Type.—Unknown.

Type-locality.—Georgia.

Other Localities.—North Carolina: Blowing Rock, F. Sherman; Black Mts., F. Knab; Linville Falls, F. Sherman; Ashville, Bear Hollow Creek, Saluda, Highlands, Schaffer; South Carolina: Rocky Bottom, Cartwright; Pinnacle Mt., Cartwright. Georgia: Neel Gap, P. W. Fattig; Yonah Gap.

Remarks.—As Horn wrote, it is odd that no one collected this species from the time Olivier described it in 1808 till Horn came along in 1892. It is the largest of the group and unlike the others, except *cruriflava*, has irregular cross ridging over the elytra. Only two of the group come from the East, the rest are found in the far West, in Oregon and California.

Colaspis thaleia Blake, new species

(Fig. 1)

Length, 6.6–7.5 mm. Width, 3–4 mm. Shining dark green with antennae and legs yellow brown, densely punctate over head and prothorax and not so densely punctate on elytra. Head with interocular space more than $\frac{1}{2}$ width of head, densely and very finely punctate with no trace of frontal tubercles and a slight midway depression down front. Prothorax not $2\times$ as wide as long with curved sides having only trace of toothing, in some specimens more apparent than in others; disc convex, very densely and finely punctate. Scutellum shining green. Elytra not $3\times$ as long as prothorax and wider, shining and without longitudinal costae except near apex, punctures in single lines near suture and apex, more or less geminate elsewhere. Body beneath dark bluish green and with dense fine punctures over prosternum, mesosternum and abdomen; legs dark brown.

Type.—♂, USNM. Type No. 73836.

Type-locality.—Cypress Ridge, Marin Co., California.

Other Localities.—Saasta Co., Sonoma Co., Fresno Co., California.

Remarks.—This is one of the group of beetles with the head nearly covered by the prothorax, and the aedeagus like all the others. Judging from the aedeagus one would think they are all one species, but the beetles themselves are different.

Colaspis cruriflava Blake

(Fig. 2)

Colaspis cruriflava Blake, 1977, Proc. Entomol. Soc. Wash. 79(2).

Length, 4–4.5 mm. Width, 2.3–2.5 mm. Elongate oblong oval, shining green with yellow brown legs, labrum and basal joints of antennae,

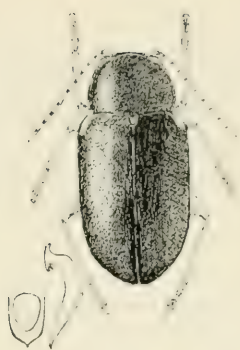
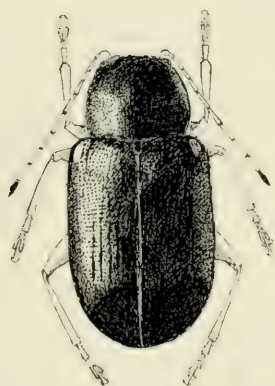
1. *Colaspis thaleia* n.sp.2. *Colaspis cruriflava* n.sp.3. *Colaspis oregonensis* n.sp.4. *Colaspis cartwrighti* n.sp.5. *Colaspis chrysos* Olivier

Fig. 1. *Colaspis thaleia*. Fig. 2. *Colaspis cruriflava*. Fig. 3. *Colaspis oregonensis*.
Fig. 4. *Colaspis cartwrighti*. Fig. 5. *Colaspis chrysos*.

densely punctate on prothorax and elytra, a slanting depression on either side of prothorax near base.

Head with interocular space more than $\frac{1}{2}$ width of head, front smooth, nearly impunctate except above frontal tubercles where very fine punctures occur. Antennae pale yellow brown with apical 4 joints dark. Prothorax not much wider than long with faint angularity below middle on side margins, surface densely and finely punctate; on each side of disc near base a slanting depression. Scutellum polished green. Elytra not quite $3\times$ as

long as prothorax and somewhat wider, densely punctate throughout, in single lines near margin and suture, in more or less geminate lines in middle of elytra. Body beneath with abdomen dark, prosternum and mesosternum green, prosternum punctate. Legs yellow brown with claws dark brown.

Type.—USNM Type No. 73484; also 2 paratypes.

Type-locality.—Canalo, Arizona, G. D. Butler, August 3, 1956.

Remarks.—In an earlier paper I described this as one of the *Colaspis favosa* group, but when I came to study the *C. chrysis* group I realized it belonged with them as it had a similarly shaped prothorax and a similar aedeagus. It is the smallest of the *chrysis* group.

Colaspis oregonensis Crotch

(Fig. 3)

Colaspis oregonensis Crotch, 1873. Proc. Acad. Sci. XXV, p. 34.

Length, 6.2 mm. Width, 2–3.3 mm. Elongate oblong oval, shining dark blue or almost copper colored, some specimens nearly black, all with yellow-brown legs and antennae. Head with interocular space more than $\frac{1}{2}$ width of head, densely punctate, head nearly concealed by prothorax. Prothorax not $2\times$ as wide as long; large and with sides almost without toothings in some specimens but in the majority with fine teeth below middle, disc very finely punctate. Scutellum dark. Elytra not $3\times$ as long as prothorax, densely and finely punctate and without any costae, very smooth, punctures near suture in single lines, irregularly geminate elsewhere. Legs dark yellow brown.

Type.—?

Type-locality.—Oregon.

Other Localities.—California: Santa Cruz, Placeville, Los Gatos.

Remarks.—This species is smaller than *C. thaleia* and dark instead of green; the color being variable with some specimens nearly black, others dark blue, and others black with a strong golden sheen over all. The antennae and legs are yellow brown. The aedeagus is the same shape as the others of the group. As in the others, the prothorax nearly hides the head.

Colaspis cartwrighti Blake, new species

(Fig. 4)

Length, 7.5 mm. Width, 4.8 mm. Elongate oval, shining dark brown with bronzy luster, legs and antennae reddish brown. Densely punctate throughout. Head with interocular space more than $\frac{1}{2}$ width of head, whole face dark and shining and very finely punctate. Antennae reddish brown. Prothorax not $2\times$ as wide as long with rounded sides and fine,

dense punctation, unusually convex. Scutellum dark and shining. Elytra approximately $3\times$ as long as prothorax and a little wider, punctures very dense and coarser than on prothorax, mostly in geminate lines with slight elevation between; in single lines near suture and margin. Body beneath shining dark brown with dense punctures on mesosternum; legs reddish brown.

Type.—♀. USNM Type No. 73837.

Type-locality.—Falls Church, Virginia, O. L. Cartwright, collector.

Remarks.—Only a single specimen, and that a female, is in the collection. Although resembling *C. chrysis* and *C. oregonensis* in shape, it differs from them in having almost costate elytra. I am naming this after its collector, who has long been an entomologist working at the US National Museum.

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20560.

TWO NEW GENERA AND FOUR NEW SPECIES OF THE
PHEROCERA-GROUP FROM WESTERN NORTH AMERICA,
WITH OBSERVATIONS ON HABITATS AND BEHAVIOR
(DIPTERA: THEREVIDAE: PHYCINAE)

Michael E. Irwin

Abstract.—*Schlingeria* n. gen. with *S. ammobata* n. sp., and *Parapherocera* n. gen. with *P. montana* n. sp., *P. wilcoxi* n. sp., and *P. macswaini* n. sp. are described. *Parapherocera* has a sister-group relationship with *Pherocera* Cole, and *Schlingeria* has a sister-group relationship with both *Pherocera* and *Parapherocera*. *Schlingeria ammobata* occurs in sandy areas in the Mojave and Colorado Deserts and all three species of *Parapherocera* occur in mountain ranges in California and Baja California, Mexico. The oviposition sequence of *Schlingeria ammobata* is described along with other behavioral traits.

The *Pherocera*-group of Therevidae was first studied by Cole (1923a, 1923b), who included four species in the genus *Pherocera* Cole. Subsequent studies of the group (Irwin, 1971) revealed the presence of several taxa new to science. Six of these are herein described to make their names available for the forthcoming Manual of Diptera of American North of Mexico. Descriptions, drawings and keys follow the format used recently in describing therevid flies (Irwin, 1973, 1976; Lyneborg, 1972, 1976).

Methods and Procedures

Each specimen has been assigned a unique number to facilitate the association of data. The number appears below the specimen on a separate yellow label bearing the following words in offset print: THEREVIDAE/M. E. IRWIN/SPECIMEN #. Numbers referring to specimens will be found throughout the text and figures in italics. These numbers will be used to incorporate ecological and label data associated with the specimens into an automated data management system originally designed by Rauch (1970).

Morphological definitions can be found in Lyneborg (1968, 1972) and Irwin (1973, 1976) and a descriptive model for oviposition behavior is given by Irwin (1976).

In order to conserve space and still include as much information about each specimen as possible, the following layout was adopted for the "specimens examined" section under each species. Many of these terms are more fully explained by Stuckenberg and Irwin (1973). 1) Largest political unit

[country, or state within the United States], 2) intermediate political unit [state or province, or country within the United States], 3) smallest political unit [city or town], 4) modifier of smallest political unit [distance (km) and direction, or subunit], 5) elevation [in meters (m) above sea level], 6) year/month/day [year expressed by two digits, the "19" has been omitted since all specimens used in this study were collected in the 1900's], 7) collector(s) [acronym(s), not in parentheses, expanded below], 8) sex [δ or ♀], 9) *specimen number* [italicized, represents adult unless otherwise stated], 10) "L" and/or "P" [these letters following the specimen number indicate that the specimen was reared from larvae or pupa and that larval (L) and/or pupal (P) exuvia are associated with the specimen], 11) depository [acronym, in parentheses, expanded below], 12) [a semicolon indicates data for previous specimen terminates and data for next specimen follows; if the subsequent specimen data listed are truncated or not complete, all data not given are identical to that for preceding specimen].

Collectors.—ALM, Melander, A. L.; AT, Tabet, A.; EIS, Schlinger, E. I.; FXW, Williams, F. X.; GIS, Stage, G. I.; GRB, Ballmer, G. R.; JCH, Hall, J. C.; JD, Doyen, J.; JW, Wilcox, J.; JWM, Macswain, J. W.; MEI, Irwin, M. E.; PAR, Rauch, P. A.; PDH, Hurd, P. D., Jr.; RCB, Bechtel, R. C.; RCD, Dickson, R. C.; RMB, Bohart, R. M.; ROS, Schuster, R. O.; and WJT, Turner, W. J.

Depositories.—AMNH, American Museum of Natural History, New York, New York; ANSP, Academy of Natural Science, Philadelphia, Pennsylvania; ASU, Arizona State University, Tempe, Arizona; BNH, Bernice P. Bishop Museum, Honolulu, Hawaii; BMNH, British Museum (Natural History), London, England; CAS, California Academy of Sciences, San Francisco, California; CIS, California Insect Survey, University California, Berkeley, California; CMNH, Field Museum of Natural History, Chicago, Illinois; CMP, Carnegie Museum, Pittsburgh, Pennsylvania; CNC, Canadian National Collection, Ottawa, Canada; CSIR, Commonwealth Scientific and Industrial Research Organization, Canberra, Australia; CU, Cornell University, Ithaca, New York; DSIR, Department Scientific and Industrial Research, Nelson, New Zealand; DZSA, Department Zoologia, University São Paulo, Brazil; INHS, Illinois Natural History Survey, Urbana, Illinois; INIA, Instituto Nacional de Investigaciones Agrícolas, Chapingo, Mexico; KUF, Kyushu University, Fukuoka, Japan; MEI, M. E. Irwin Collection; NMP, Natal Museum, Pietermaritzburg, South Africa; OSU, Oregon State University, Corvallis, Oregon; RNIIL, Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands; SMN, Staatliches Museum für Naturkunde, Stuttgart, West Germany; UA, University of Arizona, Tucson, Arizona; UCD, University of California, Davis, California; UCR, University of California, Riverside, California; UK, University of Kansas, Lawrence.

Kansas; USNM, U.S. National Museum of Natural History, Washington, D.C.; USSR, Zoological Institute USSR, Leningrad, USSR; USU, Utah State University, Logan, Utah; UZM, Universitetets Zoologiske Museum, Copenhagen, Denmark; VNM, Naturhistorisches Museum, Vienna, Austria; WSU, Washington State University, Pullman, Washington.

Schlingeria Irwin, new genus

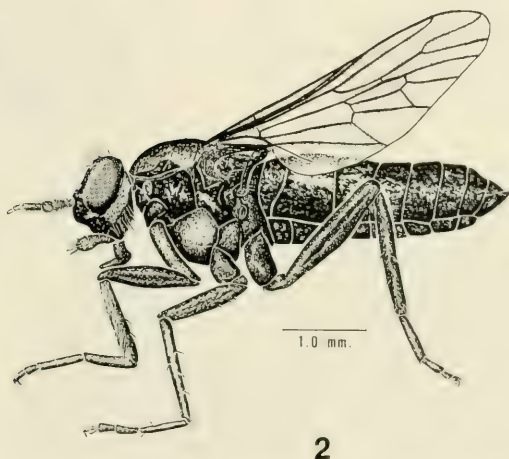
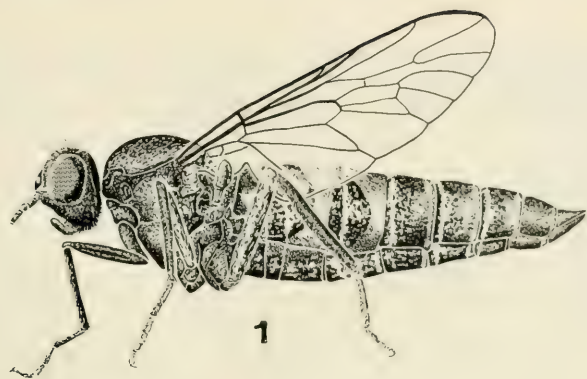
(Figs. 1, 3-5, 6-7, 11-12, 19, 21, 23, 27-29, 33, 35-41)

Derivation of Name.—Named in honor of Dr. Evert I. Schlinger, Department of Entomology, University of California, Berkeley. *Gender*: Feminine. *Type-species*: *Schlingeria ammobata* Irwin, new genus, new species, by present designation. *Included species*: *Schlingeria ammobata* Irwin.

Diagnosis.—Hypognathus; compound eyes of male separated by much less than width of anterior ocellus (Fig. 5), lower facets smaller than upper facets and with a distinct line of demarkation separating facet sizes; mouthparts small, inconspicuous; antennal style 2-segmented, last of which is an inset terminal bristle (Fig. 23); scutellar setae absent; prosternum bare; anterior surface of coxa 1 with many thin setae over entire surface; ratio $bt_1:bt_2$ about .75; femora lacking setae; wing vein r_1 not setose (Fig. 7); wing cell M_3 closed; tergum (9+)10 of female terminalia with a few reduced, spinelike setae (Fig. 21); male terminalia lacking hypandrium; dorsal gonocoxal processes strongly connected by dorsal gonocoxal bridge (Fig. 40); paraproct not connected to dorsal apodeme of aedeagus; dorsal apodeme reduced (Fig. 28); ventral apodeme elongate, forked (Fig. 27).

Description.—Medium bodied flies; length excluding antennae 4.5-7.5 mm; females larger and heavier than males.

Head: Hypognathus; frons of male at its narrowest much narrower than width of anterior ocellus (Fig. 5); frons of female at level of anterior ocellus about $2\times$ as wide as ocellar tubercle (Fig. 3); head about $\frac{3}{4}$ as high as wide; distance between eyes at lower corners of compound eyes about equal to head height (90-115%); compound eyes of female small, of uniform facet size; those of male large, with lower facets smaller than upper facets and a distinct demarkation line separating 2 facet sizes (Fig. 5); antennal insertion low (δ), about $\frac{2}{3}$ distance from vertex to genae or antennal insertion about midway between vertex and genae (φ); frons at antennal insertion 25-35% (δ) or 50-60% (φ) as wide as head; proboscis very short, partially concealed in oral cavity; palps 1-segmented, thin, sparsely covered with fine hairs (Fig. 11); antennae about $\frac{3}{4}$ as long as head depth; antennal style 2-segmented, last of which is a partially recessed terminal bristle (Figs. 12, 23); frons of female with a large shiny callus, frons of male lacking callus or callus very small; ocellar and post-



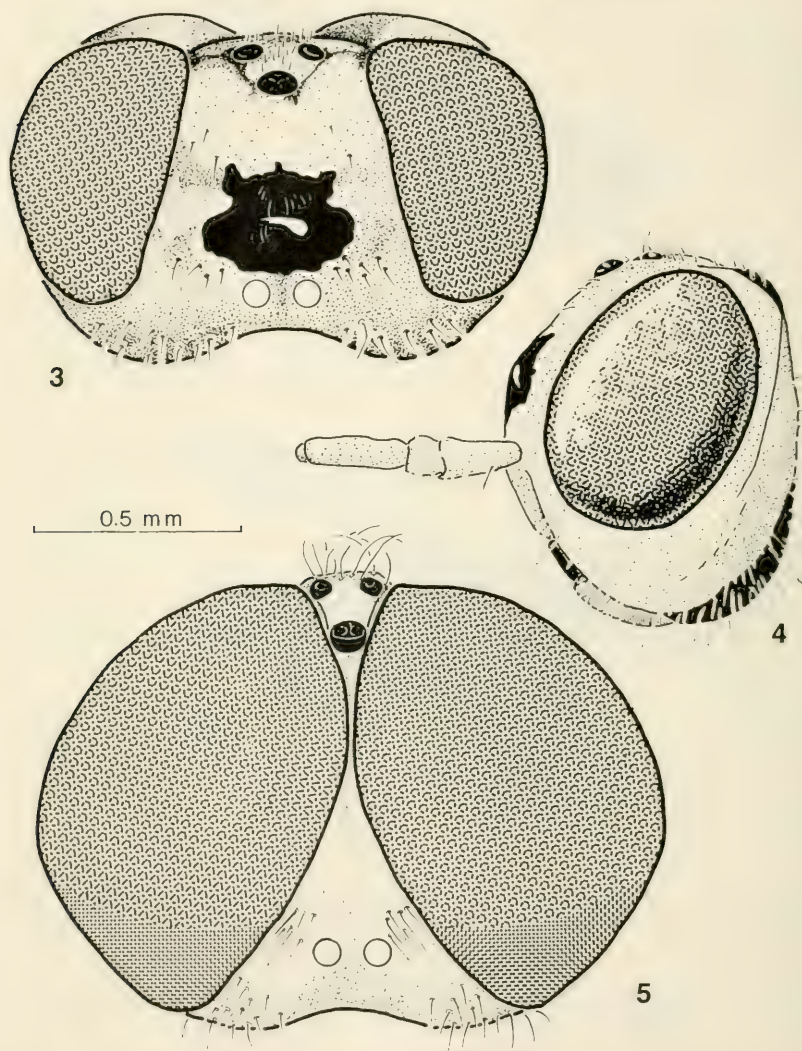
Figs. 1-2. Lateral view of flies. 1, *Schlingeria ammobata* (2855). 2, *Parapherocera montana* (1116).

ocellar hairs present and long; occipital setae absent, or at most a few lateral of postocellar hairs.

Thorax: Mesonotum nearly as wide as long (excluding length of scutellum); mesontal setae pattern: *np* usual 3 (from 3-4), *sa* always 1, *pa* always 1, *dc* from 0 to 1, *sc* always 0; prosternum without pile.

Wing (Fig. 6): Vein r_1 not setose (Fig. 7); cell M_3 closed; r_4 slightly longer than r_5 and distance from outrun of r_4 to outrun of r_5 about $\frac{1}{2}$ as long as length of r_5 (Fig. 6).

Legs: Coxa 1 with many (10-30) thin short setae over entire anterior surface; posterior surfaces of coxae 1 and 2 very sparsely tomentose, not pilose; femora without setae; tibia 1 without setae; tibia 2 lacking setae



Figs. 3-5. Head of *Schlingeria ammobata*. 3, female (282), dorsofrontal view. 4, female (282), lateral view. 5, male (233), dorsofrontal view.

in *pd* and *pv* positions, with none to a few in *av* position and with none to many (15) in *ad* position; tibia 3 lacking setae in *ad*, *pd* and *pv* positions, with several (4-8) in *av* position; males with more tibial setae than females; bt_1 about $\frac{3}{4}$ as long as bt_3 ; tibia 1 not swollen, thinner than tibia 3.

Abdomen: Abdomen of female swollen, wider than high, tapering

sharply to apex (Fig. 1); abdomen of male smaller, cylindrically-shaped and gradually tapering to apex.

Female Terminalia: Vaginal apodeme (*fur*, Fig. 21) thick, the anterior portion closed and posterior portion open, horseshoe-shaped; 3 unsclerotized spermathecae (*sp*, Fig. 21); subanal plate (*su*, Fig. 21) with sparse thin setae; tergum (9+)10 with a few reduced, spinelike setae (*t*(9+)10, Fig. 21). Penial guide anteriorly fused with thickened transverse band on sternum 8 (Fig. 21).

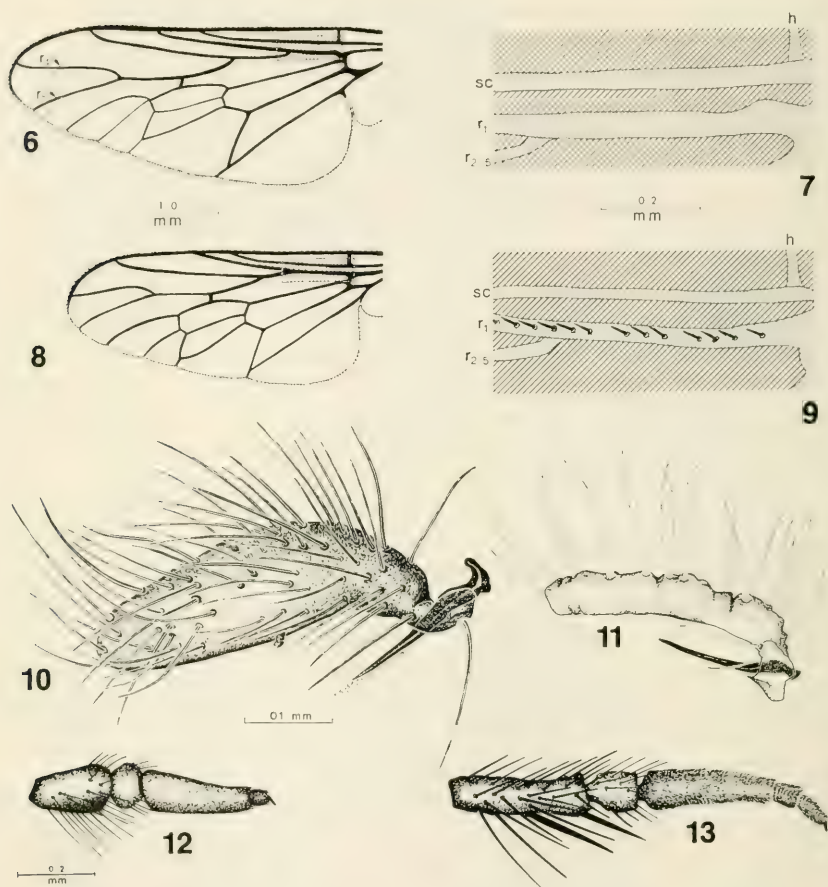
Male Terminalia: Sternum 8 (*s*8, Figs. 35, 36) somewhat rounded; tergum 8 bilobate (*t*8, Figs. 35, 37); epandrium much wider than long, situated over posterodorsal portion of gonocoxite (*e*, Figs. 35, 38); cercus slightly bilobate, both halves solidly joined, extending slightly beyond paraproct (*c*, Fig. 39); paraproct shield-shaped, not attached to dorsal apodeme of aedeagus or dorsal gonocoxal bridge of gonocoxite, with thickened, short setae (*p*, Fig. 39); gonocoxites rounded, not joined together ventrally, with 2 spinelike projections at the inner lateral posterior margin of each gonocoxite (*g*, Fig. 41); hypandrium completely lacking; dorsal gonocoxal processes (*dgp*) bulbous and strongly connected by dorsal gonocoxal bridge (*dgb*); dorsal gonocoxal rods (*dgr*) jut anteriorly, but do not exceed gonocoxal shell (Fig. 40); stylus short, not extending to tip of phallus, squat, with sharp point projecting outward and upward (*st*, Figs. 35, 40, 41); aedeagus (Figs. 27, 28) rather short and squat; ventral apodeme (*va*) elongate, reaching anteriorly almost to apex of ejaculatory apodeme; dorsal apodeme (*da*) reduced; ejaculatory apodeme (*ea*) moderately long; phallus (*ph*) curved and slender.

Phylogenetic Placement.—*Schlingeria*, from material I have examined, appears to be more closely related to two New World genera than to any of the related genera forming the Rueppelliine group of the Old World. In fact, *Schlingeria* appears to form a sister-group relationship with both *Parapherocera* Irwin and *Pherocera* Cole. *Schlingeria* can be characterized by the following apomorphic character states: Wing vein r_1 not setose, scutellum not setose, compound eyes of males with a dividing line between 2 distinct omatidia sizes, paraproct not united with dorsal apodeme of aedeagus, mouthparts very reduced, tergum (9+)10 with only a few reduced setae, hypandrium lacking.

Schlingeria ammobata Irwin, new species

Derivation of Name.—*amos* (Gr.) = sand; *bates* (Gr.) = walker.

Description.—Female, holotype, see number 2855 in Table 1 for linear measurements. Ground color dark brown to black with portions of body and legs yellow to reddish yellow; pile short, sparse, white to yellowish white over most of body; tomentum silvery, moderately dense.



Figs. 6-7. Wings of *Schlingeria ammobata* (237). 6, whole wing. 7, portion of radial sector, as shown in Fig. 6 (darkened area). Figs. 8-9. Wings of *Paraphrocera montana* (4047). 8, whole wing. 9, portion of radial sector, as shown in Fig. 8 (darkened area). Figs. 10-11. Maxillary palps of males, lateral view. 10, *Paraphrocera montana* (1155). 11, *Schlingeria ammobata* (237). Figs. 12-13. Antennae of males, lateral view. 12, *Schlingeria ammobata* (237). 13, *Paraphrocera montana* (1155). h = humeral vein; r_1 = radial vein 1; r_{2-5} = radial veins 2-5; r_4 = radial vein 4; r_5 = radial vein 5; sc = subcostal vein.

Head: Ground color black. Pile on frons sparse, short, white, longer and denser on face and genae (Fig. 3); ocellar and postocellar hairs fairly long, white, thin but dense. Dorsal occipital setae lacking or very reduced. Tomentum silver, densely covering entire head except for large frontal callus (Fig. 3), lower genae and occiput. Minimal distance between compound eyes located at hind ocelli. Compound eyes relatively small

(Figs. 3, 4). Frontal callus covering most of central frons, shiny black, with longitudinal striae; lower central area depressed giving appearance of 2 raised humps. Genal width 0.26 mm. Antennal segments dark brown, I and II with long white hairs mostly ventrally and laterally. Antennae 65–85% as long as head depth, golden to brown tomentose, with short, appressed, golden hairs. Segment I about $2\times$ as long as wide; segment II slightly wider than long; segment III elongate blunt, slightly more than $3\times$ as long as wide. Ratio of lengths of segments I II/III about $2\frac{1}{3}$. Basal segment of style large, terminal bristle not visible except under high magnification (Fig. 23). Proboscis brown, small; palps brown with sparse, long, white hairs, only reaching $\frac{2}{3}$ distance to apex of proboscis.

Thorax: Ground color of mesonotum with a central and a lateral pair (1 per side) of sparsely tomentose vittae surrounded by dense, silvery tomentum. Vittae fading posteriorly. Scutellum laterally and posteriorly densely tomentose, medially and anteriorly bare. Pile of mesonotum and scutellum thin, erect, longer posteriorly, slightly appressed, shorter anteriorly; white (about 0.14 mm long). Mesonotal setal pattern: $np = 3$, $sa = 1$, $dc = 1$, $sc = 0$. All setae yellowish white. Pteropleurite bare of tomentum; sternopleurite and pleurotergite sparsely tomentose; rest of pleurae and coxae densely silvery tomentose. Pile thin, sparse, elongate, white on anepisternum, pteropleurite and pleurotergite.

Wing (Figs. 6, 7): Veins yellowish tan, hyaline infusate with no darkened areas. Medial₃ joining m_4 0.22 mm before wing margin. Haltere with pale tan stem and white knob; stem 0.03 mm long; knob 0.40 mm long.

Legs: Femora dark brown to black with apices yellowish tan. Tibiae whitish yellow. Ratio bt_1/bt_3 , 0.73; tarsi yellow basally grading to dark brown distally. Setae pale yellow; hairs whitish. Tibial setal pattern: $t_1 [0]$, $t_2 [ad = 2, av = 0, pd = 0]$, $t_3 [ad = 0, av = 4, pd = 0, pv = 0]$.

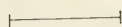
Abdomen: Ground color dark brown to black; lateral and dorsolateral portions of terga 2 and 3 (slightly on 1) yellowish orange. White fascia on posterior margins of terga 1–5 (slightly on 6). Pile thin, sparse, short, white over most of abdomen, longest, densest laterally. Tomentum sparse, silvery-gray, denser dorsolaterally and posteriorly.

Terminalia (Figs. 19, 21): As described in generic description.

Female Variation.—See Table 1, numbers 248, 255, 266, 282 for linear measurements. Females similar to one another with the following exceptions. Size varies greatly. Specimen number 266 is about 5.6 mm long; number 258 is 7.8 mm long, excluding antenna. Antennal segment I approximately 60–75% as long as segment III. Frontal callus varying in size and shape depending upon amount of tomentum worn off of specimen (Fig. 3, number 282 typical). Mesonotal setal pattern fairly constant, specimen number 255 with 4 np setae. Wing veins often disappear toward wing margin, and sometimes coalesce in odd ways, especially apically from discal cell.



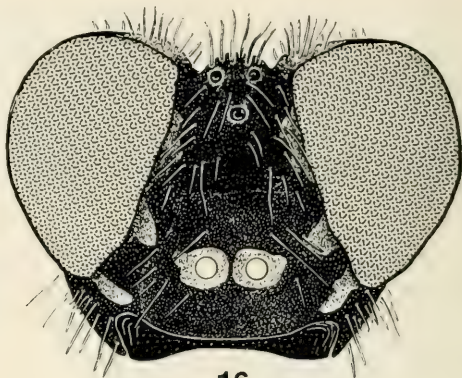
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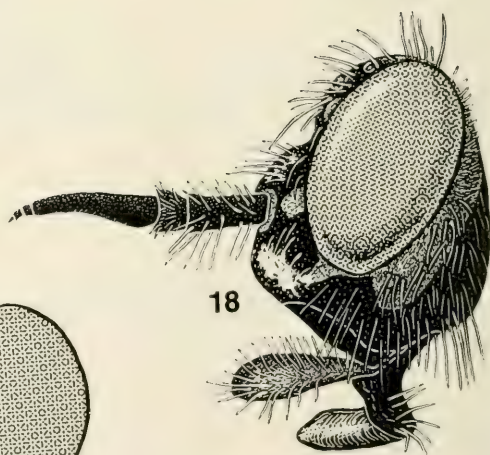
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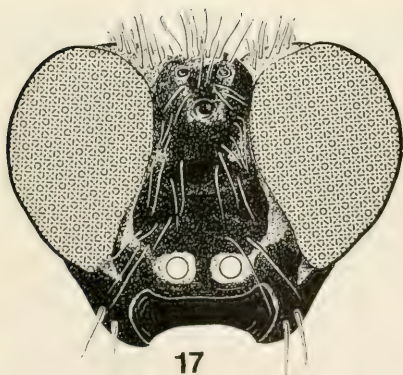
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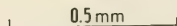
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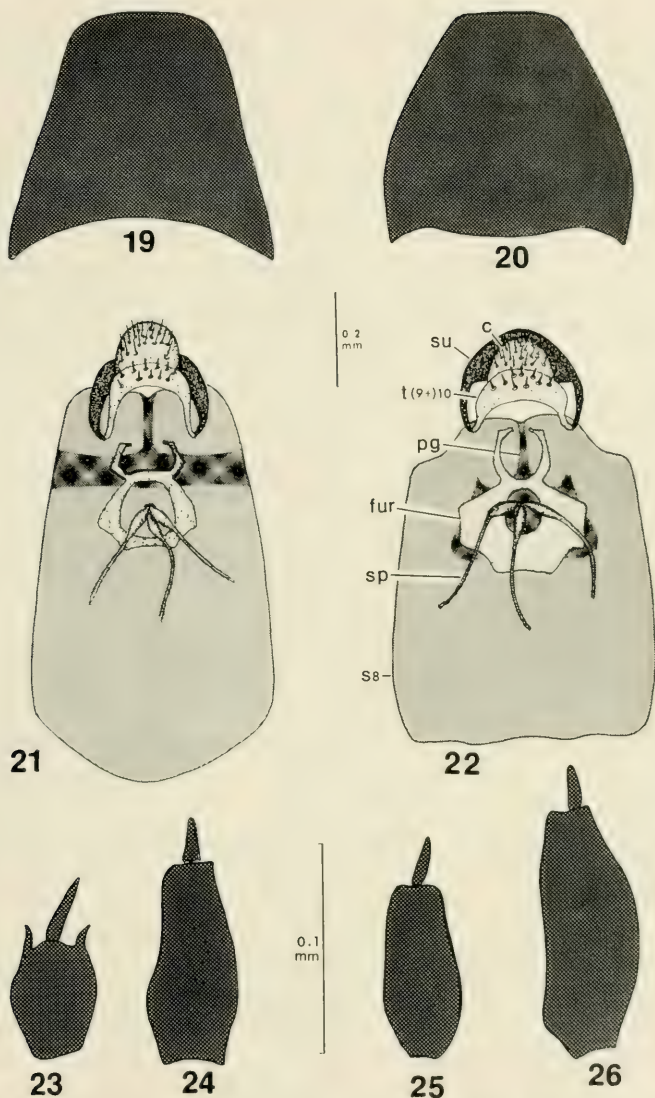


17



0.5 mm

Figs. 14-15. Dorsofrontal view of head. 14, *Parapherocera macswaini* female, holotype (1188). 15, *P. wilcoxi* female, holotype (1180). Figs. 16-18. Head of *P. montana*. 16, female (116), dorsofrontal view. 17, male (1135), dorsofrontal view. 18, female (1116), lateral view.



Figs. 19-22. Female terminalia, dorsal views. 19, tergum 8, *Schlingeria ammobata* (282). 20, tergum 8, *Parapherocera montana* (1125). 21, sternum 8 and postgenital segments, *S. ammobata* (282). 22, sternum 8 and postgenital segments, *P. montana* (1125). Figs. 23-26. Penultimate segment and terminal bristle of male antennal style, lateral view, venter to right. 23, *Schlingeria ammobata* (237). 24, *Parapherocera montana* (1155). 25, *P. wilcoxi* (1168). 26, *P. macswaini* (1184). c = cerus; fur = furca; pg = penial guide; s8 = sternum 8; sp = spermatheca; su = subanal plate; t(9+)=10 = tergum (9+)=10.

Length of coalesced m_{3+4} from 0.16 to 0.22 mm. Ratio bt_1/bt_3 from 0.71 to 0.78. Tibial setae vary as follows: t_2 [$ad = 0-2$, $av = 0-2$], t_3 [$av = 4-5$]. Abdominal color pattern varies somewhat, from orange to yellow orange. The orange colored area usually includes most to all of terga 2 and 3, but sometimes includes most of tergum 1 and portions of terga 4 and 5.

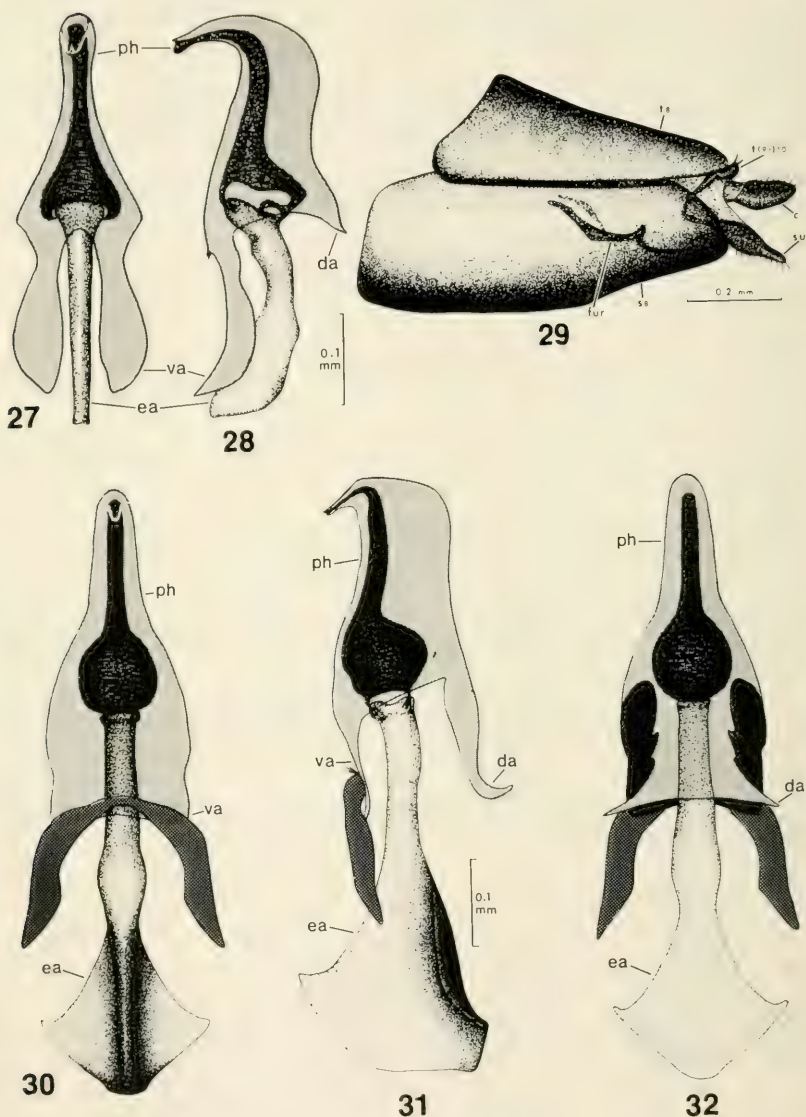
Male Description and Variation.—See Table 1, numbers 200, 210, 212, 221, 224 for linear measurements. Males similar to females except as follows: Males holoptic and head and compound eyes much larger than female in proportion to body length. Minimal distance between compound eyes from 0.01–0.02 mm, always less than width of anterior ocellus and situated at upper frons below anterior ocellus (Fig. 5). Frontal callus non-existent to thin, longitudinally placed, from antennal sockets to area between compound eyes. Antennal segment I 40–65% as long as segment III. Pile considerably longer in males than females. Mesonotal setae: np 3–4, sa 1, pa 1, dc 0–1, sc 0. Coalesced vein m_{3+4} from 0.10 to 0.26 mm long. Tibial setal pattern: t_1 [0], t_2 [$ad = 6-14$, $av = 0$, $pd = 0$, $pv = 0$], t_3 [$ad = 0$, $av = 4-7$, $pd = 0$, $pv = 0$]. Abdomen usually lacking orange coloration, occasionally some orange appears on lateral edges of terga 2 and 3.

Male Terminalia (Figs. 27–28, 35–41): As depicted under generic description. Ground color brown with white hairs. Sternum 8 (Fig. 36) with short hairs restricted to posterior $\frac{1}{3}$, most confined to posterior margin; tergum 8 (Fig. 37) with longer hairs restricted to lateral portions; epandrium (Fig. 38) 0.42 mm wide, 0.12 mm long (measured medially longitudinally and latitudinally), with short hairs mostly confined to posterolateral portions; paraproct sclerotized, rounded apically with thick, very short hairs, scattered on ventral surface. Cerci united to one another and by thin membrane to posterior margin of epandrium, with comparatively elongate hairs covering most of the dorsal surface, slightly bilobate; cerci extending slightly beyond paraproct; gonocoxites (Figs. 40, 41) moderately large, rounded; stylus blunt, short, curved inward, with outward directed point, and with thin, elongate hairs on outer dorsal surface; gonocoxite with 2 to 3 thickened, short spines on posterior margin just ventral of stylus. Distal portion of dorsal gonocoxal process bulbous, basal portion strongly connected to dorsal gonocoxal bridge (Fig. 40). Aedeagus as illustrated (Figs. 27, 28); shape of the phallus varies somewhat, being fuller in some (237) than depicted (241).

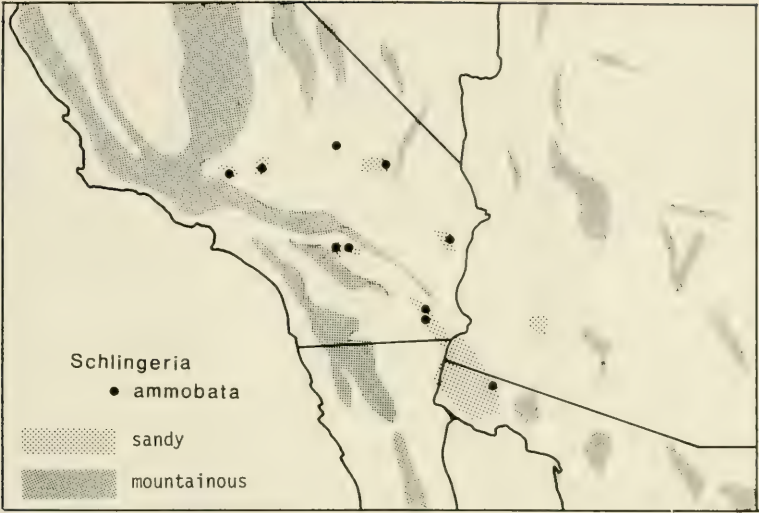
Distribution and Ecological Placement.—*Schlingeria ammobata* occurs throughout most of the Colorado and the southern portions of the Mojave Deserts of California and extends southward into the Sonora Desert of Mexico (Fig. 33). The species has been collected in the inland deserts, always in close association with shifting (and sometimes stable) sand dune environments and often associated with the following plant genera: *Cercidium*, *Larrea* and *Prosopis*.

Table 1. Measurements in mm.

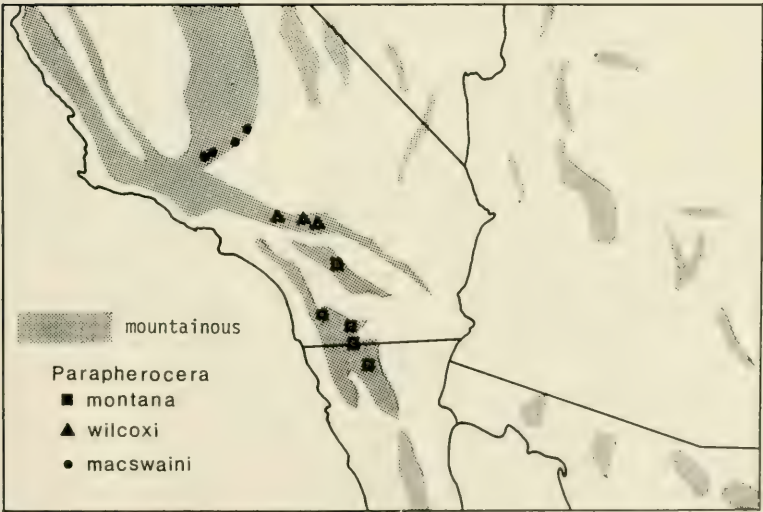
Species		<i>Schlengeria ammobata</i> Irwin											
		PARA	PARA	PARA	PARA	PARA	PARA	HOLO	PARA	PARA	PARA	PARA	PARA
Type	Sex	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀
No.		221	210	212	224	200	2855	2855	282	266	255	248	248
Total length, excluding antennae		4.7	5.4	6.1	5.5	5.3	6.9	5.8	5.8	5.6	6.7	6.8	6.8
Head width		1.40	1.56	1.80	1.62	1.64	1.36	1.36	1.36	1.30	1.52	1.50	1.50
Head height		1.16	1.20	1.32	1.20	1.26	1.04	1.00	1.00	.96	1.22	1.12	1.12
Head depth		.80	.80	.90	.80	.80	.80	.80	.70	.75	.90	.82	.82
Distance between eyes at vertex		.22	.26	.30	.26	.24	.52	.44	.44	.46	.60	.52	.52
Frontal width at anterior ocellus		.10	.10	.10	.10	.10	.50	.50	.50	.48	.58	.56	.56
Frontal width at antennae		.46	.46	.52	.50	.44	.76	.72	.72	.76	.88	.84	.84
Facial width at lower edge of eye		1.04	1.06	1.26	1.08	1.16	1.12	.90	.84	1.30	1.24	1.24	1.24
Eye height		.98	1.00	1.16	1.00	1.06	.72	.68	.64	.82	.70	.70	.70
Eye depth		.72	.70	.76	.74	.70	.56	.48	.42	.56	.54	.54	.54
Frontal protuberance depth		.00	.00	.00	.00	.00	.10	.06	.06	.10	.10	.10	.10
Antennal segment I length		.12	.16	.18	.18	.20	.20	.20	.18	.24	.24	.20	.20
Antennal segment III length		.32	.34	.36	.34	.30	.34	.30	.30	.30	.32	.32	.32
Mesonotal length (excluding scutellum)		1.16	1.44	1.60	1.34	1.40	1.38	1.32	1.24	1.60	1.40	1.40	1.40
Mesonotal width		1.16	1.28	1.46	1.26	1.34	1.18	1.26	1.10	1.44	1.30	1.30	1.30
Wing length (humeral crossvein to apex)		2.72	3.14	3.56	3.20	3.16	3.40	3.22	3.12	3.58	3.64	3.64	3.64
Wing width (maximum)		1.30	1.30	1.62	1.30	1.40	1.44	1.26	1.24	1.50	1.48	1.48	1.48
Distance fork r_{4+5} to outrun r_4		.88	.94	1.04	1.00	.90	1.02	.90	.90	1.00	1.10	1.10	1.10
Distance fork r_{4+5} to outrun r_5		.80	.82	.90	.92	.80	.92	.84	.70	.94	.98	.98	.98
Distance outruns r_4 to r_5		.38	.40	.48	.40	.42	.44	.48	.40	.46	.50	.50	.50
Coxa 1 length		.50	.60	.62	.54	.52	.64	.54	.54	.54	.70	.58	.58
Tibia 1 length		.84	1.00	1.06	1.02	.94	1.06	1.04	.94	1.14	1.14	1.14	1.14
Tibia 3 length		1.28	1.42	1.66	1.40	1.50	1.60	1.52	1.56	1.90	1.90	1.80	1.80
Basitarsus 1 length		.38	.42	.44	.40	.42	.44	.42	.40	.50	.50	.48	.48
Basitarsus 3 length		.50	.52	.60	.54	.56	.60	.56	.56	.64	.64	.62	.62



Figs. 27-28. Aedeagus of *Schlingeria ammobata* (241). 27, ventral view. 28, lateral view. Fig. 29. Female terminalia of *Schlingeria ammobata* (232), lateral view. Figs. 30-32. Aedeagus of *Parapherocera montana* (1155). 30, ventral view. 31, lateral view. 32, dorsal view. c = cercus; da = dorsal apodeme; ea = ejaculatory apodeme; fur = furca; ph = phallus; s8 = sternum 8; su = subanal plate; t8 = tergum 8; t(9+)10 = tergum (9+)10; va = ventral apodeme.



33



34

Figs. 33–34. Distribution maps of southwestern United States and northeastern Mexico, including portions of the states of California, Nevada, Arizona, Sonora, and Baja California Norte. 33, distribution of *Schlingeria ammobata*. 34, distribution of *Parapherocera*.

Specimens Examined.—Holotype, ♀, 2855, CAS type no. 10481; 10 km north of Glamis, Algodones Sand Dunes, Imperial County, California; 100 m above sea level; MEI, March 17, 1969. Paratypes, 59♂♂, 44♀♀ and 1 of unknown sex (pupa only) from the following localities:

CALIFORNIA.—Los Angeles County: Lancaster, 6 km E, 68/04/30, JCH, ♂ 239 (UCR). San Bernardino County: Kramer Hills, 53/05/01, PDH, ♀ 278 (CIS); EIS, 279 (UCR); 280; 59/04/19, EIS, ♂ 241 (MEI); ♀ 249. Cronise Valley, 65/02/14, MEI, RCD, ♂ 234 LP (UCR). Kelso, 4 km S, 65/02/13, MEI, RCD, ♀ 277 P (UCR); 17 km SSW, 670 m, 69/05/08, MEI, PAR, ♂ 2863 (UCR); 2864; 2865; 2866; 2867; 2868; 2869; 2870; 2871; ♀ 2872 (UA); 2973 (INIA); 2874 (UCR); 2875. Riverside County: Blythe, 28 km W, 120 m, 65/02/20, MEI, EIS, ♂ 222 LP (WSU); 223 LP (ASU); 224 LP (USU); 225 LP (UCR); 226 LP (CMNH); 227 LP (UK); 228 LP (USU); 229 P (AMNH); 230 P (UCR); ♀ 251 P (SMN); 252 P (USSR); 253 P (RNHL); 254 P (UCR); 255 P (VNM); 256 P (DZSA); 257 P (NMP); 258 P (KUF); 259 P (CSIR); 260 P (BNH); 261 P (DZSA); 262 P (WSU); 263 P (UCR); 264 LP (ASU); 265 LP (UCR); 266 LP (OSU); 267 LP (USU); 268 LP (CMNH); 269 LP (UK); 270 LP (AMNH); 271 P (ANSP); 272 LP (CMP); 274 P (CU); 275 LP (UCR); ? pupa only, 273 (MEI). North Palm Springs, 4.7 km N, 68/02/25, MEI, ♂ 236 (UCR). Cabazon, 8 km E, 65/02/19, MEI, EIS, ♂ 240 LP (UCR); ♀ 281 LP (UCR); 68/02/22, MEI, ♂ 238 P (UCR). Imperial County: Glamis, 12.5 km N, 100 m, 65/02/20, MEI, EIS, ♂ 231 P (UCR); 232; ♀ 276 (USNM); 9.7 km N, 100 m, 68/02/02, MEI, PAR, ♂ 194 (MEI); 195 (CAS); 196; 197 (CIS); 198 (UCR); 199; 200 (CNC); 201 (UCD); 202 (UA); 203 (UZM); 204 (INIA); 205 (BMNH); 206 (INHS); 207 (SMN); 208 (USNM); 209 (USSR); 210 (RNHL); 211 (VNM); 212 (DZSA); 213 (NMP); 214 (KUF); 215 (CSIR); 216 (BNH); 217 (DSIR); 218 (ANSP); 219 (CMP); 220 (CU); 221 (MEI); 2857; ♀ 242 (INHS); 243 (BMNH); 244 (CIS); 245 (UZM); 246 (UCR); 247 (UCD); 248 (CNC); 2855 (CAS) [HOLOTYPE]; 1.5 km W, 105 m, EIS, ♂ 233 (UCR); MEI, 237 (MEI); ♀ 282 (MEI); MEI, EIS, ♀ 250 P (MEI); 21 km W, 100 m, 69/03/17, MEI, ♂ 2858 (UCR).

MEXICO.—Sonora: Sonora, 83 km S, 48/04/21, ALM, ♂ 235 (USNM).

Behavior and Observations.—Rearing. Nearly 200 specimens of *Schlingeria ammobata* were reared from the egg stage to last-instar larvae between 1963 and 1966. Although they were reared on larvae of *Tribolium confusum* (J. duVal) in sand and most were given no free water, they remained alive and in an apparent healthy state for nearly two years. They never pupated even though alternate diets, free water, and temperature fluctuations were added to induce pupation. Day length variations were not tried, however, and this should clearly be done in the future to see if diapause can be broken.

Pupal Duration: Pupal duration within the laboratory at about 22°C lasted from 7 to 13 days (mean of 5, 10.8 days) for males, and from 8–14 days (mean of 15, 10.6 days) for females.

Predation: In the field, larvae of *Schlingeria ammobata* were occasionally attacked by myrmeliontid larvae and larvae of *Thereva semitaria* Coquillett. When kept in close proximity, larvae of *Schlingeria ammobata* became cannibalistic. In fact if several were confined in a small, sand-filled container, generally only a single specimen would survive. An adult specimen (2857) was collected being eaten by an asilid, *Efferia yuma* Wilcox (2856).

Flight: Flights were usually short in duration, low in altitude, and direct. Males of *S. ammobata*, when flying in a 30 to 35 km/hr wind, invariably flew into the wind at an angle of about 70° to the horizon. After attaining an elevation of about one meter, they would drift laterally and drop to the sand substrate, alighting two to three meters down wind from their original take off points.

Under windy conditions, females tended to rest in sheltered areas nearer and often under vegetation. Their flight was lower, more direct and averaged a greater ground distance than males.

Wind Adaptations: In a moderate to high velocity wind (above 25 km/hr) specimens tended to press their bodies as closely to the substrate as possible, and maneuver themselves into small dune ripples.

Oviposition: Female *S. ammobata* lay an average of 50 eggs. Below is a description of the oviposition behavior; the sequencing is after Irwin (1976).

- | | |
|------------|---|
| Approach. | The female walked forward on her hind two pairs of legs, the tip of her abdomen lightly touching the substrate and the forelegs waving in front just above the surface. |
| Stance. | The head was held rather high and the abdomen held low. Her hind legs were stretched far behind the tip of her abdomen but to one side or the other. |
| Insertion. | A pit was dug with the hind legs. As the hind leg pushed posteriorly from the thorax, some sand was shoved behind her abdomen. The hind legs were alternately pushed-pulled, each push shoving sand backwards, each pull lifting the legs above the substrate. The tip of the abdomen always remained in contact with the bottom of the pit. The pit when completed was about 4.5 mm deep. The abdomen, upon completion of the pit, was thrust deep into the bottom of the pit; only the first abdominal segment remained visible above the surface of the pit bottom. Following this, a half-second rest ensued. |

- Egg-laying. A quick contraction of abdominal muscles presumably caused an egg to be laid.
- Withdrawal. As the abdomen withdrew, her hind legs were alternately pulled forward, dragging sand into the pit. This continued until the pit was completely filled in.
- Rest. A very short rest followed, after which the fly moved about 3 cm forward and repeated the sequence.
- Timing. The entire sequence lasted approximately 30 seconds, but as the number of sequences increased, the length of each sequence also increased.

Parapherocera Irwin, new genus

(Figs. 2, 8-10, 13-18, 20, 22, 24-26, 30-32, 34, 42-48)

Derivation of Name.—*Para* = closely related to; *Pherocera* = a genus of therevids described by Cole (1923a). *Gender:* Feminine. *Type-species:* *Parapherocera montana* Irwin, new genus, new species, by present designation. *Included species:* *P. montana* Irwin, *P. macswaini* Irwin, and *P. wilcoxi* Irwin.

Diagnosis.—Hypognathus; compound eyes of male separated by at least width of ocellar tubercle (Fig. 17), all facets same size; mouthparts large; protuberance on face below antennae extending anteriorly beyond frons (Fig. 18); antennal style 3-segmented, last of which is a terminal bristle (Figs. 13, 24, 25, 26); very little tomentum on head; prosternum bare; anterior surface of coxa 1 with many thin elongate setae; ratio bt_1/bt_3 about 1.00; femora lacking setae; wing vein r_1 setose (Fig. 9); wing cell M_3 closed; tergum (9+)10 of female terminalia with a few, reduced, spinelike setae (Fig. 22); male terminalia lacking hypandrium; dorsal gonocoxal processes strongly connected by dorsal gonocoxal bridge; paraproct strongly united with dorsal apodeme of aedeagus and dorsal gonocoxal bridge (Fig. 47); ventral apodeme with forked appendage (Figs. 30, 31, 32).

Description.—Medium to thin bodied flies (Fig. 2); length excluding antennae, 4.2-4.9 mm; males and females of similar size.

Head: Hypognathus; male dichoptic, the frons very wide at its narrowest point (Fig. 17), always much wider than $2\times$ the width of the anterior ocellus; frons of female at level of anterior ocellus about $2\times$ as wide as ocellar tubercle (Fig. 16); frons of female slightly wider than that of male; head about $\frac{3}{4}$ as high as wide; distance between compound eyes at lower corners of eyes slightly less than head height; compound eyes of both sexes small, of uniform facet size (Figs. 16, 17, 18); antennal insertion about midway between ventral portion of genae and vertex; frons at antennal insertion about equal to $\frac{1}{2}$ of head width; proboscis elongate,

clearly visible; palps 1-segmented, long, heavy (Figs. 10, 18), and covered with thick hairs; antennae as long or longer than head depth (except for female *P. macswaini* which have antennae slightly shorter than head depth); antennal style 3-segmented, last of which is a terminal bristle (Figs. 13, 24, 25, 26); frons of both sexes mostly shining with a few patches of tomentum along compound eye margins; face below antennae protruding anteriorly farther than frons above antennae (Fig. 18); ocellar and postocellar hairs long, sparse; occipital setae short, inconspicuous, present.

Thorax: Mesonotum about 80–90% as wide as long (excluding length of scutellum); mesonotal setal pattern: *np* usually 3 (from 2–4), *sa* always 1 (one specimen with 2 on one side), *pa* always 1, *dc* from 0 to 1, *sc* always 1; prosternum without pile; anepisternum, pleurotergite and pteropleurite without tomentum; rest of pleural region and coxae with silver tomentum.

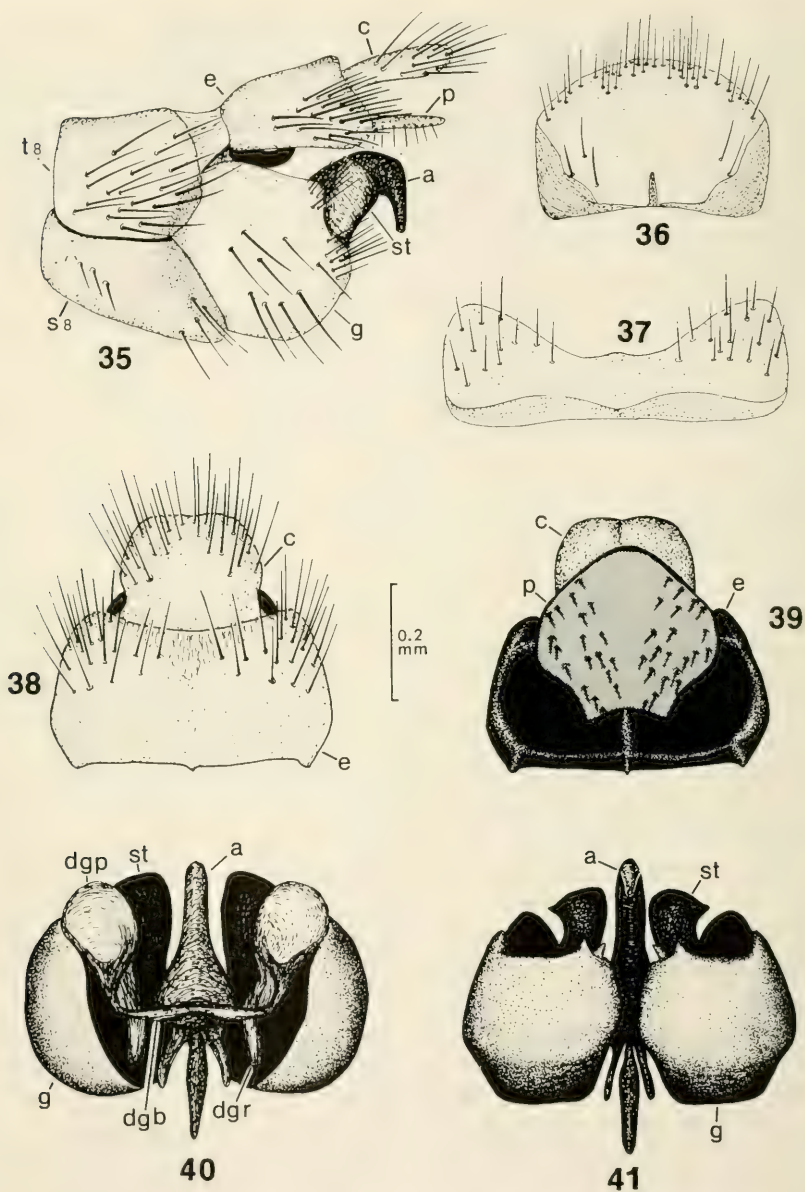
Wing: Vein r_1 setose (Fig. 9); cell M_3 closed; veins r_4 and r_5 about equal in length; distance from outrun of r_4 to outrun r_5 30–50% as long as r_5 (usually 33–45%) (Fig. 8).

Legs: Coxa 1 with many (40 or more) long setae over entire anterior surface; posterior surfaces of coxae 1 and 2 very sparsely tomentose, not pilose; femora without setae; tibia 1 lacking setae or with at most a single seta in the *ad* position, with 0–2 in the *av* position, 0–3 in the *pd* position and 0–5 in the *pv* position; tibia 2 with 1–4 in *ad* position, 0–2 in *ad* position, 1–4 in *pd* position, and 1–3 in *pv* position; tibia 3 with 3–6, usually 4, in *ad* position, 3–7 in *av* position, 0–6 in *pd* position, and 0–2, usually 0, in *pv* position; bt_1 and bt_3 about equal in length; tibia 1 swollen, thicker than tibia 3.

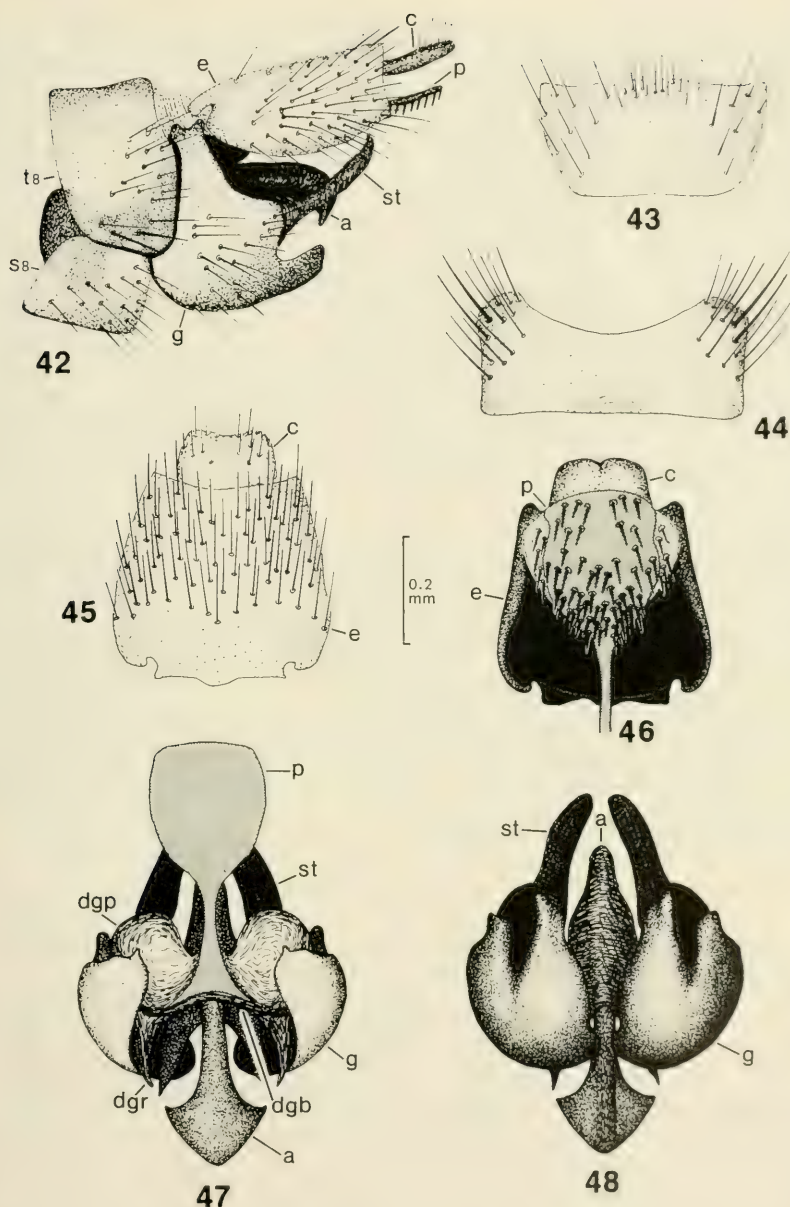
Abdomen: Abdomen of both sexes cylindrical, tapered posteriorly (Fig. 2).

Female Terminalia: Vaginal apodeme (*fur*, Fig. 22) very thick, the anterior portion closed and posterior portion open, horseshoe-shaped; 3 unsclerotized spermathecae (*sp*, Fig. 22); subanal plate (*su*, Fig. 22) with sparse, thin setae; tergum (9+)10 with a few reduced, spinelike setae (*t*(9+)10, Fig. 22); penial guide anteriorly fused with thickened bow-like flaps attached to sternum 8 (*pg*, *s8*, Fig. 22).

Male Terminalia: Sternum 8 (*s8*, Figs. 42, 43) squarish; tergum 8 (*t8*, Figs. 42, 44) somewhat bilobate, with thickened, elongate setae on posterolateral margins; epandrium about as long as wide measured medially longitudinally and latitudinally (*e*, Figs. 42, 45, 46), the posterior $\frac{3}{4}$ covered with setae; cercus slightly bilobate, both halves solidly joined to one another and extending posteriorly slightly beyond paraproct (*c*, Figs. 42, 45, 46); paraproct elongate shield-shaped, its base firmly attached to dorsal apodeme of aedeagus, dorsal gonocoxal process, and dorsal gonocoxal bridge, with



Figs. 35-41. Male terminalia of *Schlingeria ammobata*. 35, lateral view (226). 36, sternum 8 (241), ventral view. 37, tergum 8 (241), dorsal view. 38, epandrium and cercus (241), dorsal view. 39, epandrium, cercus and paraproct (241), ventral view. 40, gonocoxite and aedeagus (241), dorsal view. 41, gonocoxite and aedeagus (241), ventral view. a = aedeagus; c = cercus; dgb = dorsal gonocoxal bridge; dgp = dorsal gonocoxal process; dgr = dorsal gonocoxal rod; e = epandrium; g = gonocoxite; p = paraproct; s8 = sternum 8; st = stylus; t8 = tergum 8.



Figs. 42–48. Male terminalia of *Parapherocera montana* (4047). 42, lateral view. 43, sternum 8, ventral view. 44, tergum 8, dorsal view. 45, epandrium and cercus, dorsal view. 46, epandrium, cercus and distal portion of paraproct, ventral view. 47, gonocoxite and aedeagus, dorsal view. 48, gonocoxite and aedeagus, ventral view. a = aedeagus; c = cercus; dgb = dorsal gonocoxal bridge; dgp = dorsal gonocoxal process; dgr = dorsal gonocoxal rod; e = epandrium; g = gonocoxite; p = paraproct; s8 = sternum 8; st = stylus; t8 = tergum 8.

elongate, thickened setae becoming dense basally (*p*, Figs. 42, 46, 47); gonocoxites with 2 posteroventral projections (*g*, Fig. 48); gonocoxite not joined together ventrally (Fig. 48); hypandrium completely lacking; dorsal gonocoxal process (*dgp*) enlarged, bulbous and strongly connected to basal portion of paraproct (Fig. 47) and to dorsal gonocoxal bridge (*dgb*); dorsal gonocoxal bridge strong, uniting 2 gonocoxites (Fig. 47); dorsal gonocoxal rod (*dgr*) jutting anteriorly and exceeding gonocoxal shell (Fig. 47); stylus (*st*) elongate, projecting posteriorly beyond phallus (*ph*) (Figs. 42, 47, 48); aedeagus rather large, complex (Figs. 30, 31, 32); ventral apodeme (*va*) short, broad with an extra forked process attached to its apex (not identified, Figs. 30, 31, 32); dorsal apodeme (*da*) long, broad, apically sharply curved dorsad (where it attaches to basal end of paraproct); ejaculatory apodeme (*ea*) very large, extending well into abdomen (Fig. 42), rather triangular anteriorly and wedged-shaped (Figs. 30, 31, 32); phallus (*ph*) thin and deep with a very short, curved apical section (Figs. 30, 31).

Phylogenetic Placement: *Parapherocera* clearly has a sister-group relationship with *Pherocera* and can be characterized by the following apomorphic character states: Ventral apodeme of aedeagus with extra forked structure; ejaculatory apodeme of aedeagus very enlarged; stylus of aedeagus elongate, sickle-shaped; palps enlarged; tergum (9+)10 with only a few reduced setae; hypandrium lacking.

The species within the genus *Parapherocera* are very closely related to one another, but it appears as though *P. montana* has a sister-group relation to both *P. macswaini* and *P. wilcoxi*, and the latter two have a sister-group relationship with each other.

Key to the Species of *Parapherocera* Irwin

1. Abdominal segments 1-2 (sometimes 3) orange *montana* Irwin
 - Entire abdomen brown to black 2
2. Penultimate segment of antennal style very large (Fig. 26) (greater than 0.1 mm); female tibia 1 without setae in *av* position; ground color light brown, chocolate colored *macswaini* Irwin
 - Penultimate segment of antennal style small (Fig. 25) (less than 0.1 mm); female tibia 1 with 1-2 setae in *av* position; ground color dark brown to black *wilcoxi* Irwin

Parapherocera montana Irwin, new species

Derivation of Name.—*montana* (Latin) = montane, pertaining to mountains.

Description.—Female holotype (Fig. 2), see number 1116 in Table 2 for

Table 2. Measurements in mm.

Species		<i>Paraphrocera montana</i> Irwin											
Type	PARA	PARA	PARA	PARA	PARA	PARA	HOLO	PARA	PARA	PARA	PARA	PARA	
Sex	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀	
No.	1135	1140	1153	1143	1132	1116	1114	1121	1120	1144			
Total length, excluding antennae	5.0	4.7	4.8	5.4	4.6	5.5	5.9	5.0	5.7	4.4			
Head width	1.32	1.30	1.24	1.44	1.26	1.38	1.36	1.22	1.44	1.16			
Head height	.96	.96	.96	1.10	.94	1.00	1.08	.92	1.08	.90			
Head depth	.80	.72	.66	.70	.68	.70	.76	.70	.84	.70			
Distance between eyes at vertex	.30	.26	.28	.30	.26	.34	.38	.32	.40	.30			
Frontal width at anterior ocellus	.28	.22	.26	.30	.26	.36	.38	.36	.42	.32			
Frontal width at antennae	.60	.56	.60	.68	.56	.70	.70	.60	.72	.60			
Facial width at lower edge of eye	.90	.84	.74	.90	.82	.90	1.20	.94	1.00	.84			
Eye height	.70	.74	.70	.84	.70	.76	.74	.68	.80	.64			
Eye depth	.60	.54	.50	.58	.52	.52	.52	.50	.60	.48			
Frontal protuberance depth	.14	.14	.12	.16	.14	.14	.14	.14	.16	.14			
Antennal segment I length	.30	.28	.30	.34	.30	.30	.32	.28	.32	.28			
Antennal segment III length	.40	.44	.44	.48	.40	.44	.44	.42	.44	.40			
Mesonotal length (excluding scutellum)	1.28	1.20	1.20	1.36	1.18	1.32	1.40	1.20	1.38	1.14			
Mesonotal width	1.12	1.04	1.08	1.22	1.00	1.12	1.26	1.04	1.24	.90			
Wing length (humeral crossvein to apex)	3.00	3.14	3.12	3.44	2.90	3.22	3.48	3.02	3.42	2.70			
Wing width (maximum)	1.22	1.24	1.24	1.34	1.24	1.24	1.34	1.22	1.36	1.04			
Distance fork r_{4+5} to outrun r_1	.80	.92	.88	1.04	.98	.86	1.00	.76	1.10	.78			
Distance fork r_{4+5} to outrun r_5	.80	.92	.88	1.00	.92	.86	.98	.76	1.00	.74			
Distance outruns r_1 to r_5	.34	.36	.36	.38	.28	.36	.40	.38	.44	.26			
Coxa 1 length	.80	.80	.80	.88	.78	.84	.90	.80	.84	.76			
Tibia 1 length	1.16	1.16	1.08	1.24	1.12	1.16	1.36	1.14	1.30	1.08			
Tibia 3 length	1.62	1.76	1.64	1.80	1.70	1.76	1.96	1.60	1.92	1.50			
Basitarsus 1 length	.60	.64	.60	.66	.58	.66	.66	.60	.72	.58			
Basitarsus 3 length	.64	.68	.62	.66	.60	.66	.72	.60	.72	.60			

linear measurements. Ground color black with portion of abdomen orange; pile short, moderately dense, mostly black; tomentum sparse, silvery, covering small portion of body.

Head: Pile on frons moderately dense, long, black; upper face bare; genae with moderately dense, black pile; ventral occipital pile long, dense, white; dorsal occipital setae very short, about 7 pairs confined to areas laterad of ocellar tubercle; ocellar and postocellar hairs long, black, 3 pairs. Tomentum densely silver, confined to 6 small patches all adjacent to compound eyes: 2 laterad and slightly ventrad of anterior ocellus, 2 laterad of antennal insertions, and 2 at interface of genae and face (Fig. 16); silvery tomentum along hind margin of compound eye at lateral margin of occiput. Minimal distance between compound eyes located at posterior ocelli. Compound eyes of moderate size. Genal width 0.26 mm. Antennal segments dark brown, I with elongate black hairs mostly ventrad, II with shorter black hairs, III with elongate tomentum (Fig. 13). Antennae $1.2\times$ as long as head depth. Segment I about $3\times$ as long as wide; segment II as long as wide; segment III about $3\frac{1}{2}\times$ as long as wide, elongate tapered. Segments I/II III, 6 $\frac{2}{9}$. Style 3-segmented, last of which is a terminal bristle (Fig. 24). Palps and proboscis conspicuous, reaching beyond oral cavity; dark brown with black hairs.

Thorax: Mesonotum with a pair of sparsely tomentose silvery vittae fading posteriorly, surrounded by sparsely tomentose black and non-tomentose areas. Scutellum with sparse, erect, black pile; mesonotum with shorter semi-appressed black pile anteriorly, becoming larger and more erect posteriorly. A pair of lines of the mesonotum contain hairs that are slightly larger than the normal hairs but no thicker; these occupy the dorsocentral setal zone. Mesonotal setal pattern: $np = 3$, $sa = 1$, $pa = 1$, $dc = 0$, $sc = 1$. All setae black. Prosternum lacking pile; anepisternum, sternopleurite and pleurotergite with sparse, thin, white pile.

Wing (Figs. 8, 9): Veins brown to dark brown, hyaline between. Medial; joining m_1 0.22 mm before wing margin. Haltere brown with yellow-brown knob; stem 0.36 mm long; knob 0.32 mm long. Vein r_1 about as long as r_5 ; distance between outruns of r_1 and r_5 42% as long as length of r_4 .

Legs: Dark brown with orangish light brown on apical $\frac{1}{5}$ of femora 1 and 2, dorsal side of tibia 2, and whitish on dorsal and outer lateral sides of tibia 1. Bt_1 about the same size as bt_3 . Setae black; tibial setal pattern: t_1 [$ad = 0$, $pd = 1$, $pv = 3$], t_2 [$ad = 4$, $av = 1$, $pd = 1$, $pv = 2$], t_3 [$ad = 5$, $av = 3$, $pd = 2$, $pv = 0$].

Abdomen: Ground color of segments 1-3 yellowish orange; rest of abdomen black or very dark brown. Pile sparse, short, black on terga 1-3; longer, yellow brown on anterior lateral surfaces of tergum 1; very short, brown on segments 4-8. Tomentum very sparse.

Terminalia (Figs. 20, 22): As depicted under generic description.

Female Variation.—See Table 2, numbers 1114, 1120, 1121, 1144 for linear measurements. Females very similar except as follows: Size varies from 4.4 mm (1144) to 6.4 mm (1131), excluding antennae. Antennal segments I/II/III with ratio of 14/6/23 to 18/6/27. Tomentose areas on frons and face vary; specimen 1131 with most of tomentum rubbed off; most specimens without obvious tomentum on upper frons. Mesonotal setal pattern fairly consistent; specimen 1144 with *np* 2 on one side, 3 on other; specimen 1120 with *sa* 1 on one side, 2 on other. Length of coalesced wing vein m_{3+4} from 0.06 to 0.22 mm. Ratio bt_1/bt_3 from 0.91 to 1.00. Tibial setae vary as follows: t_1 [*ad* 0–1, *pd* 0–1, *pv* 2–4], t_2 [*ad* 2–4, *av* 1–2, *pd* 1–3, *pv* 1–2], t_3 [*ad* 4–5, *av* 3–5, *pd* 1–5, *pv* 0–2].

Male Description and Variation.—See Table 2, numbers 1132, 1135, 1140, 1143, 1153 for linear measurements. Males similar to females except as follows: Males dichoptic but minimal distance between compound eyes on frons not as great (0.22 to 0.30 mm for males compared to 0.30 to 0.40 for females) (compare Fig. 17 with 16). Antennal segment I 64–75% as long as segment III. Pile longer on males. Legs entirely brown. Mesonotal setae very similar except 2 specimens had only 2 *np* setae (1132, 1135). Coalesced vein m_{3+4} from 0.12 to 0.18 mm long. Tibial setal pattern: t_1 [*ad* 0, *av* 0, *pd* 1–3, *pv* 2–5], t_2 [*ad* 2–3, *av* 0–2, *pd* 2–4, *pv* 3–5], t_3 [*ad* 4–5, *av* 3–5, *pd* 0–4, *pv* 0–2]. Abdominal orange coloration mostly confined to terga 1 and 2.

Male Terminalia (Figs. 30–32, 42–48): Sternum 8 with setae along lateral margins and with shorter group of setae along medial posterior margin (*s*8, Figs. 42, 43). Tergum 8 with strong setae along posterolateral margins (*t*8, Figs. 42, 44). Epandrium with setae covering most of dorsal surface (*e*, Figs. 42, 45). Cercus slightly bilobate, its dorsal surface with sparse, thin setae (*c*, Figs. 42, 45, 46). Gonocoxite with a few setae on lateral surface (*g*, Fig. 44).

Distribution and Ecological Placement.—*Parapherocera montana* occurs throughout the mountainous regions of southern California and northern Baja California, south of the transverse ranges of the San Gabriel and San Bernadino Mountains. The species has been collected in the San Jacinto-Santa Rosa Mountain Range in Riverside County, the Laguna Mountains in San Diego County, California, and in the Sierara Juarez Range of Baja California, Mexico (Fig. 34). Specimens have been collected from 900–1,500 meters above sea level. *Parapherocera montana* has usually been collected in sandy washes in pine-sagebrush woodland. One specimen was collected in a malaise trap.

Specimens Examined.—Holotype, ♀, 1116, CAS type no. 10450; about 6 km south of La Rumorosa, Baja California Norte, Mexico; 1,321 m altitude; MEI; April 18, 1964; sandy creek bottom. Paratypes, 19 ♂♂, 26 ♀♀ from the following localities:

CALIFORNIA.—Riverside County: Santa Rosa Mts. 1½ km N Jet. Deep

Creek and Horsethief Creek, 73/04/18–25, AT, ♀ 323918 Univ. Calif. Insect Survey (UCR). San Diego County: Oak Grove, 64/04/13, JW, ♂ 1155 (UCR). Buckman Springs, near, 53/05/07, FXW, ♀ 1150 (MEI); ♂ 1151 (CAS); 1152 (CIS); 1153 (MEI); 1154 (CIS). Anza State Park, Culp Canyon, 59/04/04, EIS, ♂ 1140 (UA); 1141 (INIA); 1142 (UCD); 1143 (MEI); ♀ 1144 (MEI); 1145 (UCR); 1146 (INIA); 1147 (UCR); JCH, ♀ 1148 (CAS); 1149 (UCR).

MEXICO.—Baja California Norte: La Rumorosa, 6 km S, 1,321 m, MEI, ♀ 1113 (USNM); 1114 (CNC); 1115 (UCR); 1116 (CAS) [HOLOTYPE]; 1117 (UZM); 1118 (CIS); 1119 (BMNH); 1120 (INHS); 1121 (UA); 1122 (MEI); 4044 (MEI); ♂ 1132 (MEI); 1133 (CAS); 1134 (USNM); 1135 (CNC); EIS, ♀ 1123 (UCD); 1124 (UCR); 1126 (UCR); 1127 (MEI); ♂ 1125 (UCR); 1136 (UCR); 1137 (UZM); 1138 (INHS); 4047 (MEI); 16 km S, 1,402 m, EIS, ♀ 1128 (MEI); MEI, ♀ 1129 (UCR); 1130 (UCR); ♂ 1139 (BMNH).

Parapherocera wilcoxi Irwin, new species

Derivation of Name.—Named in honor of Mr. Joe Wilcox, University of California, Riverside.

Description.—Female, holotype, see number 1180 in Table 3 for linear measurements. Ground color dark brown; pile short, moderately dense, mostly black; tomentum sparse, silvery, covering only small portion of body. This species very similar to *P. montana* with the following differences:

Head (Fig. 14): Pile on genae relatively sparse, black; pile on ventral portion of occiput long, tan, denser. Dorsal occipital setae similar to those of *P. macswaini* but not elongate, extending somewhat further along margin of occiput. Several pairs of thin, elongate, black ocellar and postocellar hairs. Genal width 0.26 mm. Antennal segments dark brown, head depth about 86% of antennal length. Segments I/II/III, about 3/1/5. Penultimate segment of antennal style small (Fig. 25).

Thorax: Scutellum with sparse, thin pile. Mesontal setal pattern: $np = 3$, $sa = 1$, $pa = 1$, $dc = 0$, $sc = 1$.

Wing: Veins medium brown, hyaline between. Medial₃ joining m₄ 0.12 mm before wing margin. Haltere stem and knob medium brown; stem 0.28 mm long; knob 0.24 mm long. Vein r₄ about the same length as vein r₅. Distance between outruns of r₄ and r₅ 42% as long as length of r₄.

Legs: Ground color dark brown. Yellowish brown on distal 1/3 of femur 1, distal 1/2 of femur 2, and distal 1/3 of femur 3. Tibiae 1 and 2 yellowish basally fading to brown apically. Tibia 1 basal 2/3 whitish cream, apical 1/3 brown; tarsi brown. Bt₁ about as long as bt₃. Tibial setal pattern: t₁ [$ad = 0$, $av = 1$, $pd = 0$, $pv = 0$], t₂ [$ad = 1$, $av = 2$, $pd = 1$, $pv = 3$], t₃ [$ad = 4$, $av = 5$, $pd = 3$, $pv = 0$].

Table 3. Measurements in mm.

Species	<i>Paraphrocera wilcoxi</i> Irwin									
Type	PARA δ	PARA δ	PARA δ	PARA δ	PARA δ	HOLO δ	PARA δ	PARA δ	PARA δ	PARA δ
Sex	1163	1165	1169	4046	4045	1180	1175	1177	1169	1169
No.										
Total length, excluding antennae	4.8	4.8	4.2	5.2	4.5	5.6	5.7	5.4	4.2	
Head width	1.32	1.20	1.10	1.40	1.28	1.36	1.40	1.30	1.08	
Head height	.96	.94	.86	1.04	.96	1.00	1.04	1.02	.80	
Head depth	.68	.76	.64	.72	.70	.74	.68	.70	.58	
Distance between eyes at vertex	.26	.26	.28	.32	.26	.32	.30	.50	.30	
Frontal width at anterior ocellus	.24	.24	.28	.24	.20	.20	.36	.36	.30	
Frontal width at antennae	.66	.60	.56	.64	.58	.64	.66	.70	.60	
Facial width at lower edge of eye	.90	.82	.80	.92	.94	.96	1.00	.94	.78	
Eye height	.72	.70	.58	.80	.74	.74	.74	.72	.56	
Eye depth	.48	.60	.48	.60	.60	.58	.46	.46	.44	
Frontal protuberance depth	.10	.14	.14	.12	.12	.14	.14	.14	.12	
Antennal segment I length	.28	.26	.26	.30	.24	.28	.28	.32	.26	
Antennal segment III length	.44	.44	.38	.44	.38	.48	.46	.46	.38	
Mesonotal length (excluding scutellum)	1.24	1.16	.98	1.30	1.10	1.28	1.30	1.30	1.00	
Mesonotal width	1.14	1.00	.88	1.08	1.00	1.16	1.16	1.16	.90	
Wing length (humeral crossvein to apex)	3.16	3.00	2.64	3.22	2.94	3.26	3.40	3.10	2.60	
Wing width (maximum)	1.36	1.24	1.06	1.28	1.16	1.34	1.42	1.30	1.00	
Distance fork r_{4+5} to outtrun r_4	.86	.88	.72	.92	.82	.86	1.00	.84	.72	
Distance fork r_{4+5} to outtrun r_5	.84	.88	.72	.92	.84	.86	.98	.84	.70	
Distance outtruns r_4 to r_5	.34	.32	.26	.32	.28	.36	.36	.34	.26	
Coxa 1 length	.74	.76	.68	.84	.74	.84	.84	.88	.66	
Tibia 1 length	1.22	1.12	1.02	1.24	1.06	1.30	1.28	1.24	1.04	
Tibia 3 length	1.76	1.66	1.48	1.78	1.56	1.84	1.84	1.82	1.50	
Basitarsus 1 length	.68	.60	.60	.70	.58	.64	.68	.68	.58	
Basitarsus 3 length	.68	.62	.64	.70	.58	.64	.70	.68	.60	

Abdomen: Ground color medium brown overall. Pile short, sparse, brown to light brown over entire abdomen.

Female Variation.—See Table 3, number 1180, 1175, 1177, 1169 for linear measurements. Length 4.1 mm (1170) to 5.7 mm (1175), excluding antennae. Ratio antennal segments I/II/III from 13/6/26 (1175) to 15/6/23 (1172). Mesonotal setal pattern fairly constant; specimens 1175 and 1177 had 1 pair of *dc* setae. Length of coalesced wing vein m_{3+4} from 0.10 to 0.22 mm. Ratio bt_1/bt_3 from 0.97 to 1.00. Tibial setae vary as follows: t_1 [*av* 1-2], t_2 [*ad* 1-2, *av* 1-2, *pd* 1-2, *pv* 1-3], t_3 [*av* 4-5, *pd* 3-5].

Male Description and Variation.—See Table 3, numbers 1163, 1165, 1169, 4046, 4045 for linear measurements. Length 4.1 mm (1158) to 5.2 mm (4046), excluding antennae. Males similar to males of *P. montana* and *macswaini* except as follows: Eyes of male closer together than in other 2 species, especially toward vertex; minimal distance between compound eyes 0.20 to 0.28 mm. Antennal segment I 60-70% as long as segment III. Legs very dark brown except for some yellowish brown on distal $\frac{1}{2}$ of femur 2 and basal $\frac{1}{4}$ of tibia 2 in specimens 1157, 1166, 1162, 1158. Ratio bt_1/bt_3 from 0.93 to 1.00. Mesonotal setal pattern very consistent, specimen 4045 with one side having $np = 3$, other side 4; specimens 1165 and 4045 with 1 pair of *dc* setae. Coalesced vein m_{3+4} from 0.08 to 0.14 mm long. Tibial setal pattern: t_1 [*ad* 0, *av* 0, *pd* 0-1, *pv* 1-3], t_2 [*ad* 2-4, *av* 1-2, *pd* 1-4, *pv* 2-3], t_3 [*ad* 3-5, *av* 4-7, *pd* 3-5, *pv* 0-1]. Abdomen brown, male terminalia very similar to *P. montana*.

Distribution and Ecological Placement.—*Parapherocera wilcoxi* occupies the transverse mountain ranges of southern California and has been collected from the San Bernardino Mountains from elevations of 2,000-2,300 meters above sea level (Fig. 34).

Specimens Examined.—Holotype, ♀ 1180, CAS type no. 10451; Big Bear Lake, San Bernardino Co., California, JW, May 25, 1965. Paratypes, 15♂♂, 11♀♀ from the following localities:

CALIFORNIA.—San Bernardino County: Big Bear Lake, 65/05 25, JW, ♀ 1180 (CAS) [HOLOTYPE]. Camp Baldy, 2,000 m, 65/06 26, RCB, ♂ 1156 (CAS); 1157 (MEI); 1158 (UCD); 1159 (CIS); 1160 (UZM); ♀ 1177 (INHS); 1178 (MEI); 1179 (MEI); RMB, ♂ 1161 (UCR); 1162 (USNM); 1163 (CNC); 1164 (BMNH); 1165 (INHS); 1166 (MEI); 1167 (MEI); 1168 (MEI); ♀ 1169 (MEI); 1170 (UCD); 1171 (CIS); 1172 (UZM); 1173 (UCR); 1174 (USNM); 1175 (CNC); 1176 (BMNH). Sugarloaf Mountain, 2,330 m, 72/05 07, GRB, ♂ 4045 (UCR); 4046 (UCR).

Parapherocera macswaini Irwin, new species

Derivation of Name.—Named in honor of the late Dr. John W. MacSwain, University of California, Berkeley.

Table 4. Measurements in mm.

	Species Type Sex No.	<i>Parapherocera macswaini</i> Irwin				
		PARA	PARA	PARA	HOLO	PARA
		♂ 1186	♂ 1182	♂ 1184	♀ 1188	♀ 1181
Total length, excluding antennae		5.0	5.0	—	5.3	5.7
Head width		1.30	1.36	—	1.30	1.42
Head height		1.00	1.00	—	.96	1.08
Head depth		.70	.68	—	.78	.84
Distance between eyes at vertex		.34	.32	—	.34	.42
Frontal width at anterior ocellus		.32	.30	—	.38	.44
Frontal width at antennae		.64	.76	—	.68	.68
Facial width at lower edge of eye		.90	.88	—	.90	1.00
Eye height		.74	.78	—	.66	.80
Eye depth		.54	.56	—	.56	.62
Frontal protuberance depth		.12	.10	—	.16	.16
Antennal segment I length		.30	.24	—	.24	.24
Antennal segment III length		.40	.40	—	.40	.40
Mesonotal length (excluding scutellum)		1.20	1.20	1.20	1.20	1.26
Mesonotal width		1.08	1.04	1.00	1.04	1.16
Wing length (humeral crossvein to apex)		3.28	3.20	3.30	3.20	3.44
Wing width (maximum)		1.26	1.28	1.40	1.20	1.34
Distance fork r_{4+5} to outrun r_4		1.00	.88	1.04	.98	.90
Distance fork r_{4+5} to outrun r_5		.96	.84	1.02	.98	.94
Distance outruns r_4 to r_5		.32	.30	.36	.32	.40
Coxa 1 length		.84	.76	.78	.80	.84
Tibia 1 length		1.18	1.06	1.20	1.16	1.20
Tibia 3 length		1.70	1.56	1.80	1.72	1.76
Basitarsus 1 length		.66	.62	.66	.64	.64
Basitarsus 3 length		.70	.68	.66	.66	.64

Description.—Female, holotype, see number 1188 in Table 4 for linear measurements. Ground color chocolate brown; pile short, moderately dense, mostly black; tomentum, sparse, silvery, covering small portion of body. This species very similar to *P. montana* with the following differences:

Head (Fig. 15): Pile on genae relatively sparse, black; on ventral surface of genae (i.e. lower occiput), denser and tan; a few of the dorsal occipital setae fairly long (0.2 mm); several pairs of ocellar and postocellar hairs. Genal width 0.30 mm. Antennal segments medium brown. Head depth about equal to length of antennae. Segments I II III, 5 2 S. Penultimate segment of antennal style very large (Fig. 26).

Thorax: Scutellum with very sparse, thin pile, almost bare. The line of taller hairs on the mesonotum follows tomentose vittae. Mesonotal setal pattern with $np = 3$, $sa = 1$, $pa = 1$, $dc = 1$, $sc = 1$.

Wing: Veins light brown, hyaline between. Medial₂ joining m_1 0.14

mm before wing margin. Haltere stem and knob yellow brown, light colored; stem 0.30 mm long; knob 0.34 mm long. Vein r_4 about equal in length to r_5 ; distance between outruns of r_4 and r_5 about $\frac{1}{2}$ as long as length of r_4 .

Legs: Ground color medium brown basally to yellowish brown apically. Most of femur 1 medium brown, apical $\frac{1}{5}$ yellowish; femur 2, apical $\frac{1}{2}$ yellowish; femur 3, apical $\frac{1}{5}$ yellowish. Tibia 1 with basal $\frac{2}{3}$ whitish cream, apical $\frac{1}{3}$ brown; other tibiae yellowish; tarsi brown. Bt_1 about as long as bt_3 . Tibial setal pattern: t_1 [*ad* 0, *av* 0, *pd* 2, *pv* 2], t_2 [*ad* 2, *pv* 2, *pd* 3, *pv* 2], t_3 [*ad* 4, *av* 4, *pd* 4, *pv* 0].

Abdomen: Ground color chocolate brown overall. Pile sparse, short, black on terga 1-2, brown on segments 3-8, yellow brown on anterolateral margin of tergum 1. Tomentum sparse.

Female Variation.—See Table 4, numbers 1188, 1181 for linear measurements. Size varies from 4.3 mm (1187) to 5.7 mm (1181), excluding antennae. Antennal segments ranging from 12/5/18 (1187) to 13/5/26 (1181). Mesonotal setal pattern fairly constant, but most specimens lack *dc* setae. Length of coalesced wing vein m_{3+4} from 0.12 to 0.14 mm. Ratio bt_1/bt_3 from 0.97 to 1.00. Tibial setae vary as follows: t_1 [*pv* 1-2], t_2 [*av* 1-2, *pd* 2-3, *pv* 1-2], t_3 [*ad* 4-5, *pv* 0-1].

Male Description and Variation.—See Table 4, numbers 1186, 1182, 1184 for linear measurements. Length 4.1 mm (1185) to 5.0 mm (1183), excluding antennae. Males similar to males of *P. montana* except as follows: Minimal distance between compound eyes 0.30-0.32 mm. Antennal segment I 60-70% as long as segment III. Legs brown, except specimen 1182 which has tibia 2 yellowish brown. Ratio bt_1/bt_3 from 0.91 to 1.00. Mesonotal setal pattern very consistent. Coalesced vein m_{3+4} from 0.14 to 0.18 mm long. Tibial setal pattern: t_1 [*ad* 0, *av* 0, *pd* 0-2, *pv* 2-3], t_2 [*ad* 1-3, *av* 1, *pd* 1-5, *pv* 1-2], t_3 [*ad* 3-6, *av* 4-5, *pd* 5-6, *pv* 0]. Abdomen entirely brown with male terminalia very similar to *P. montana*.

Distribution and Ecological Placement.—*Pherocera macswaini* occurs in the extreme southeastern portion of the Sierra Nevada Mountain Range of southern California (Fig. 34).

Specimens Examined.—Holotype, ♀, 1188, CAS type no. 10449, Short Canyon, about 9 km west of Inyokern, Kern Co., California, JWM, April 11, 1954. Paratypes, 5♂♂, 4♀♀ from the following localities:

CALIFORNIA.—Kern County: Short Canyon, 9 km W Inyokern, 54/04/11, JWM, ♂ 1185 (CIS); 1186 (CAS); ♀ 1187 (CIS); 1188 (CAS) [HOLOTYPE]; 59/03/29, GIS, ♀ 1189 (UZM). Sand Canyon, 5 km W Brown, 66/04/07, RCS, ♀ 1190 (UCD); Walker Pass, 63/05/14, JW, ♂ 1183 (UZM); 1184 (MEI); 1.5 km W, 64/04 26, JD, ♀ 1181 (MEI); WJT, ♂ 1182 (MEI).

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PHORIDAE (DIPTERA) ASSOCIATED WITH CULTIVATED
MUSHROOMS IN EASTERN NORTH AMERICA

William H Robinson

Abstract.—*Megaselia (M.) halterata* (Wood) is the most widespread and important pest of cultivated mushrooms in the U.S. The larvae of this phorid infest the mushroom beds and feed on the developing mycelium. In the U.S., six *Megaselia* species have been reported as pests of cultivated mushrooms. A review of the history and taxonomy of these species, however, indicates that only one, *M. halterata*, is the dominant pest at this time. Accurate identification of the phorids commonly associated with cultivated mushrooms is facilitated by the accompanying figures of the male and female terminalia. Although one mushroom phorid is dominant in the U.S. at this time, the expansion of the mushroom industry to other parts of the world increases the possibility of new pest phorids.

Phorid flies are the most widespread and perhaps the most important pests of cultivated mushrooms. Several species in the genus *Megaselia* have been reported attacking cultivated mushrooms in the U.S. and western Europe. Larvae of some species feed on and destroy the mushroom mycelium, while larvae of other species feed on the fruiting bodies. Adult phorids are pests because of the large number that invade mushroom houses, and their potential as vectors of mushroom-disease pathogens. The adults may also be a nuisance by invading private homes in areas adjacent to mushroom farms.

The substantial commercial value of cultivated mushrooms in the U.S. and other countries has prompted investigations of their pest fauna. Workers in western Europe have identified three *Megaselia* species as pests of cultivated mushrooms: *Megaselia halterata* (Wood), *M. nigra* (Meigen), and *M. bovista* (Gimmerthal). However, only *M. halterata* is a consistent economic pest at this time. In the U.S., six *Megaselia* species have been implicated as mushroom pests. But only one species is dominant. This species has been known under a variety of names: *Megaselia agarici* (Lintner), *M. bovista*, *M. halterata*, and *M. dakotensis* (Borgmeier).

The objectives of this paper are to review the taxonomy and history of the *Megaselia* species reported attacking cultivated mushrooms, to elucidate which species is currently the primary pest in mushroom houses in eastern U.S., and to provide diagnostic characters for identifying the *Megaselia* species associated with cultivated mushrooms in the U.S.

A review of the historical development of cultivated-mushroom entomology was provided by Hussey (1972). Some of the significant papers on the

taxonomy and biology of phorids infesting cultivated mushroom include Thomas (1942), Schmitz (1948), Colyer (1954, 1956), Hussey (1959, 1960), Borgmeier (1967), and Robinson (1975). Recent papers on the control of mushroom pests include Hussey and Hughes (1964), Hussey (1965, 1969), Hussey et al. (1969), Wyatt (1969), Parsells (1974), and Spencer (1976).

Material and Methods

Centers of commercial mushroom production in eastern U.S., both past and present, were visited and surveyed for phorids. Mushroom farms in New York, Pennsylvania, Delaware, and Virginia were surveyed in 1973-76. Museum specimens from Michigan, South Dakota, and California were also examined.

The British Museum (Natural History) supplied specimens of *Megaselia bovista*. Specimens of *M. halterata* were provided by Dr. E. S. Binns of the Glasshouse Crops Research Institute. Type-material of several *Megaselia* species was examined at the U.S. National Museum, and the New York State Museum.

Voucher specimens were deposited in the collection of the U.S. National Museum and in the Insect Collection, Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg.

Taxonomy and History of Mushroom Phorids

Although several *Megaselia* species have been reported attacking cultivated mushrooms in the U.S., not all of the reports are accurate and some of the species are no longer serious pests. A review of the taxonomy and the association which these species have had with cultivated mushrooms may help eliminate some of the confusion.

Megaselia (Megaselia) nigra (Meigen) (Figs. 2, 3, 10)

Synonymy: *Phora albidihalteris* Felt, 1898; *Aphiochaeta albidihalteris* Felt. Popenoe, 1912; *Aphiochaeta smithii* Brues. Thomas, 1939.

Diagnosis.—This species can be distinguished from other North American *Megaselia* by the combination: Mesanepisternum bare; scutellum with 2 strong bristles, costa about 0.46% (rarely 0.42%) of wing length; halteres yellow; hind tibia of male flattened on apical $\frac{1}{3}$. Hypopygium with epandrium (Fig. 2) with 6-9 strong bristles; hypandrium (Fig. 3) with a hooked process at apex of left lobe. Oviscapt with sternum 6 (Fig. 10) clavate, and with 6-7 bristles.

Known Distribution.—Europe, North America.

Larval Biology.—The larvae tunnel in the stems and caps of mushrooms.

Remarks.—This phorid has been reported attacking cultivated mushrooms in Europe and North America. The first reports of *M. nigra* associated with mushrooms were Dufour (1841), and Scholtz (1849) in western Europe. Moreton (1954) and Hussey (1959, 1961) reviewed the biology of this fly.

Megaselia nigra was the most important fly pest of cultivated mushrooms in western Europe until the early 1950's. At that time *M. halterata* emerged as the dominant phorid pest. The reports of Felt (1898), Popenoe (1912), and Thomas (1931) indicate that *M. nigra* (as *Phora albidihalteris*) was also a pest of the mushroom industry in the U.S. It was considered a pest of cultivated mushrooms in the U.S. until about the early 1940's. At that time *M. agarici* emerged as the dominant pest.

Hussey (1959) found that *M. nigra* will lay eggs only where natural light falls on mushroom beds. In most commercial farms damage occurred only near the doors of the mushroom houses. More efficient ventilation systems which enable the doors of the mushroom houses to remain shut have practically eliminated this species as a pest. *Megaselia nigra* is not now a serious pest of cultivated mushrooms in Europe or the U.S.

Megaselia (Megaselia) bovista (Gimmerthal)
(Figs. 6, 7)

Synonymy: *Phora bovista* Gimmerthal, 1848.

Diagnosis.—This species can be distinguished from other North American *Megaselia* by the combination: Mesanepisternum bare; scutellum with 2 strong bristles; costa 0.36–0.44% of wing length; halteres yellow; dorsal row of setae on hind tibia sharply deflected. Hypopygium with epandrium (Fig. 6) without strong bristles; hypandrium (Fig. 7) with large setose lobe.

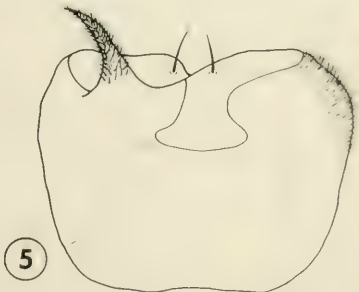
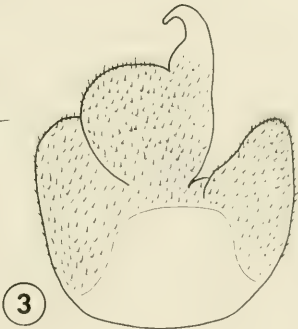
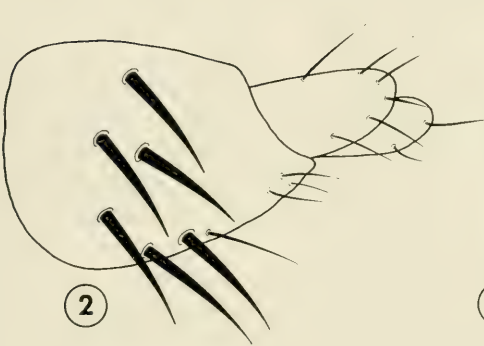
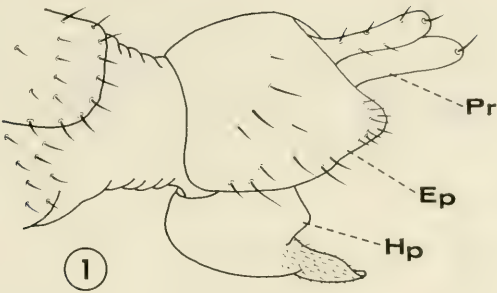
Known Distribution.—Europe.

Larval Biology.—The larvae tunnel in the stems and caps of mushrooms.

Remarks.—This species is usually presented as one of the three most important phorid pests of cultivated mushrooms in western Europe. (The other species are *M. nigra* and *M. halterata*.) However, *M. bovista*'s reputation as a pest is based on a single outbreak in Staffordshire, England in 1953 (Colyer, 1956). It is uncommon to almost rare phorid in cultivated mushroom houses in England at this time (E. S. Binns, personal com-

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Figs. 1–5. *Megaselia* spp. male genitalia. 1, *Megaselia* sp., male hypopygium. 2, *M. nigra*, epandrium. 3, *M. nigra*, hypandrium. 4, *M. halterata*, epandrium. 5, *M. halterata*, hypandrium. Pr, proctiger; Ep, epandrium; Hp, hypandrium.



munication). Hussey (1961) presented data on the biology and immature stages of *M. bovista*.

There have been several reports of *M. bovista* infesting cultivated mushrooms in the U.S. Snetsinger (1972) reported *M. bovista* as the most common phorid in Pennsylvania mushroom houses. A review of the voucher material reported on by Snetsinger indicated that *M. halterata* was the phorid actually observed.

Megaselia (Megaselia) halterata (Wood)
(Figs. 4, 5)

Synonymy: *Megaselia* (*M.*) *plurispinosa* (Zetterstedt) Moreton, 1954; Colyer, 1956; *Megaselia* (*M.*) *dakotensis* Borgmeier, 1966; Norton and Ide, 1974; *Megaselia* (*M.*) *agarici* (Lintner) Weigel et al., 1959; *Megaselia* (*M.*) *bovista* (Gimmerthal), Kline, 1971.

Diagnosis.—This species can be distinguished from other North American *Megaselia* by the combination: Mesanepisternum bare; scutellum with 2 strong bristles; costa about 0.37% of wing length; halteres yellow. Hypopygium with epandrium (Fig. 4) with 2–3 strong bristles laterally on right; hypandrium (Fig. 5) with left lobe reduced to a thorn-like process. Oviscapt with sternum 6 absent.

Known Distribution.—Europe, North America.

Larval Biology.—The larvae feed primarily on mushroom mycelium.

Remarks.—*Megaselia halterata* is the dominant and the most important phorid pest of cultivated mushrooms in western Europe and the U.S. Broekhuizen (1938) first reported it associated with fungi. Hussey (1961), Hussey and Gurney (1964) and Kline (1971) presented data on the biology and immature stages. Colyer (1956) and Robinson (1975) reviewed the taxonomy.

This species was first recognized as a pest of cultivated mushrooms in western Europe in 1953. In the latter part of that year the number of *M. halterata* in English mushroom houses increased and the infestation spread in epidemic proportions. This outbreak apparently dislodged *M. nigra* and established *M. halterata* as the dominant pest in Europe.

Megaselia halterata was first reported from the U.S. in 1975. Information on museum specimens indicated that this species may have been present in North America since about 1906.

Megaselia (Megaselia) agarici (Lintner)
(Figs. 8, 9, 11)

Synonymy: *Phora agarici* Lintner, 1895; *Megaselia* (*M.*) *bovista* (Gimmerthal) Borgmeier, 1966; Snetsinger, 1972; Girard et al., 1972.

Diagnosis.—This species can be distinguished from other North Ameri-

can *Megaselia* by the combination: Mesanepisternum bare; scutellum with 2 strong bristles; costa about 0.38% of wing length; halteres yellow. Hypopygium with epandrium (Fig. 8) lacking strong bristles, pale; unarticulated process extends beneath proctiger; hypandrium (Fig. 9) with left lobe narrowed apically. Oviscapt with sternum 6 (Fig. 11) capitate, with 4 bristles.

Known Distribution.—North America.

Larval Biology.—The larvae feed on mushroom mycelium, stems, and caps.

Remarks.—*Megaselia agarici* was originally described as a pest of cultivated mushrooms in the U.S. (Lintner, 1895). Although widespread in the U.S., it has never been reported from western Europe.

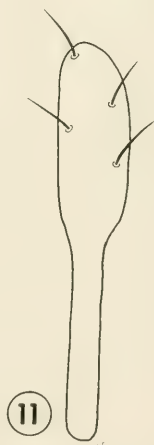
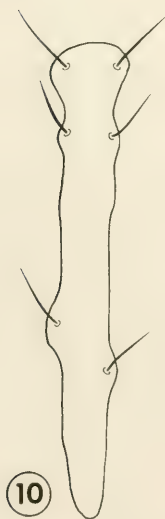
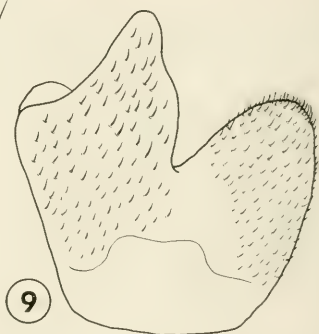
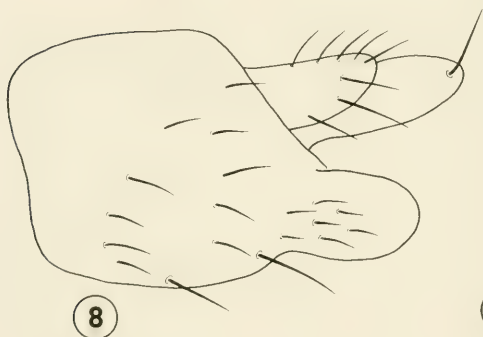
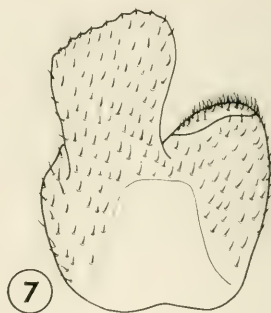
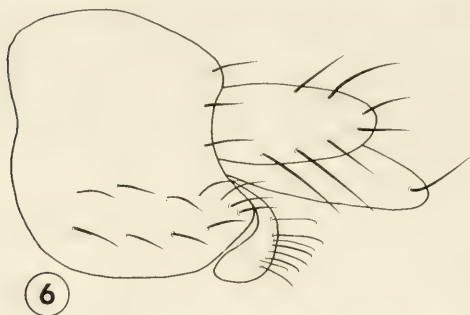
This species is usually considered the most important phorid pest of cultivated mushrooms in the U.S. However, it may not be as widespread or as important as previously thought. Although *M. agarici* was described as a pest of mushrooms in 1895, it was not reported again as a pest until 1934. Even in Thomas' (1942) paper *M. agarici* was not emphasized as an important pest. *Megaselia nigra* was treated as an equal, if not a more important pest at that time. *Megaselia bovista* does not occur in the U.S.

Megaselia agarici followed *M. nigra* in the succession of phorid pests in North American mushroom farms. This species was distributed in the major centers of mushroom production, such as the Kennett Square area in Pennsylvania and the area south of Albany, New York in the Hudson River Valley. Mushroom production in the New York location has greatly diminished in the last 15 years. This resulted in the disappearance of *M. agarici* in the remaining mushroom houses, and an absence of *M. halterata*.

Megaselia agarici has encountered some taxonomic problems. Lintner described *M. agarici* from many specimens and did not designate a holotype. A lectotype was selected by Robinson (1975) from 22 adults in the collection at the New York State Museum and Science Service. Borgmeier (1966) did not examine any of the original *M. agarici* material when he prepared his revision of the North American Phoridae. In the course of revising *Megaselia* he "provisionally" (but in fact) synonymized *M. agarici* with *M. bovista*. A year later, with the help of C. H. Colyer, Borgmeier (1967) stated *M. agarici* was indeed a valid species. Many workers were unaware that Borgmeier had changed his mind on the synonymy of *M. agarici*. Consequently, there are a few published reports that cite *M. bovista* as a pest of mushrooms in the U.S. (Girard, et al., 1972; Snetsinger, 1972).

Megaselia (M.) pygmaea (Zett.)

This species was reported as a pest of cultivated mushrooms by Thomas (1931). Since this phorid is not known to occur in the U.S. and voucher



specimens are not available, this record probably represents a misdetermination.

Megaselia (M.) longipennis (Malloch)

This species was reported [as *M. flavinervis* (Malloch)] as a pest by Thomas (1942). But there is no evidence that it was present in economically-important numbers. *Megaselia longipennis* has been reported feeding on a variety of materials (Robinson, 1971) and is probably not restricted to feeding on mushrooms.

Megaselia (M.) iroquoiana (Malloch)

This species was reported as a pest by Davis (1938) and Thomas (1942). There is no evidence it was present in economically-important numbers. *Megaselia iroquoiana* has been reared from dead insects (Weise, 1916) and is probably not restricted to feeding on mushrooms.

Results and Discussion

The commercial mushroom industry in the U.S. (and western Europe) has experienced several different *Megaselia* species as pests. At least three species (*M. nigra*, *M. agarici* and *M. halterata*) have been present in numbers high enough to cause economic damage to the crop. *Megaselia nigra* was a pest during the early period of mushroom production in the U.S. But improved growing methods eliminated it as a pest, only to allow *M. agarici* to emerge as the dominant pest. Within the past 10–15 years *M. halterata* has replaced *M. agarici*.

Two phorid pests (*M. nigra* and *M. halterata*) of commercial mushrooms in the U.S. were apparently introduced from western Europe. Hussey (1973) suggested that the importation of old-style mushroom spawns may have led to the introduction into the U.S. of pest species from European mushroom farms. *Megaselia halterata* has probably been in the U.S. for many years. Apparently, only recently have the conditions in U.S. mushroom houses been conducive for the increase in numbers of this phorid. When and how *M. halterata* replaced *M. agarici* are not known. It is interesting to note that while *M. nigra* and *M. halterata* were successfully introduced into the U.S., *M. agarici* has apparently not been introduced into western Europe.

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Figs. 6–11. *Megaselia* spp. 6, *M. bovista*, epandrium. 7, *M. bovista*, hypandrium. 8, *M. agarici*, epandrium. 9, *M. agarici*, hypandrium. 10, *M. nigra* female, sternum 6. 11, *M. agarici* female, sternum 6.

The history of phorid pests of commercial mushrooms in the U.S. shows that rarely is one species dominant for a very long time. The current species, *M. halterata*, may eventually be supplanted by another native or introduced species. Schmitz (1948) reviewed the records of several phorid genera with species known to be associated with fungi. Robinson (1971) listed more than 30 *Megaselia* species known to feed on fungi.

The mushroom industry has spread from the traditional centers in western Europe and the U.S. to new areas in the Far East. As the commercial mushroom industry spreads to new zoogeographic regions there is the threat of immigrations and emigrations of phorid pests. Hussey (1973) warned that future changes in commercial mushroom production methods, or the culture of other species of fungi, may lead to changes in the relative importance of pest species, or may mean species of pests new to the mushroom industry.

Phorid flies will probably always be a serious pest of cultivated mushrooms, wherever they are grown. Their importance will remain constant, but the pest species may change. Before effective control measures can be implemented, the pest must be accurately identified. Mushroom growers around the world should be alert to new outbreaks or unusual infestations of phorid pests. Phorids should be sampled periodically and voucher specimens submitted for identification.

Acknowledgments

I am grateful for the help provided by Drs. John McDaniel, Department of Entomology, University of Delaware; K. R. Valley, Pennsylvania Department of Agriculture; W. W. Wirth, Systematic Entomology Laboratory, IIBIII, Agric. Res. Serv. USDA; and W. Cantelo, Vegetable Laboratory, USDA. Mr. E. Binns, Glasshouse Crops Research Institute, England provided valuable information and specimens. Dr. K. G. V. Smith, British Museum (Natural History) was kind enough to loan important specimens. This work was supported in part by a USDA/ARS Cooperative Agreement with the Insect Identification and Beneficial Insect Introduction Institute, BARC. Dr. W. W. Wirth and Dr. W. Cantelo reviewed and improved the manuscript.

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A DESCRIPTION AND CLASSIFICATION OF SOME FINAL INSTARS
OF THE THERIINI (ICHNEUMONIDAE: ANOMALINAE)

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Abstract.—The characters of the final instars of the Theriini are reviewed on knowledge of species belonging to four genera. Characters are listed for the tribe and a key is given for these genera. The Theriini, like other Anomalinae, strongly resemble the Metopiinae on larval characters; it is argued that this is due to convergence associated with a similarity in larval habit.

Since the publication (Short, 1959, 1970) of descriptions and classifications of the final instars of the Anomalinae, Townes (1971) has revised this subfamily on adult characters. Here I revise and extend the descriptions of the final instars of the known genera of the Theriini and give revised keys for the identification of these genera.

The Theriini, like most Anomalinae, are endoparasites of Lepidoptera; they oviposit in the larva and emerge from the pupa.

In 1959 I described the methods used in preparing and mounting the larvae from the cocoons of bred material. The terminology of the head parts, together with its basis in comparative morphology, is given in Short (1952). Detailed records (by whom determined, locality, sex, etc.) are not listed here for specimens in major museums, since this information can be obtained from the data labels of the collections of bred material studied. When a larval skin was extracted from the cocoon of a bred specimen a label was added to the pin reading "larval skin removed, JRTS, 197X." Reference can be made from the slide preparation to the records on the pin of the reared adult. On slide preparations the origin of the material is recorded as well as the determination. Material returned to the U.S. National Museum is indicated by the initials (USNM) and material placed in the Hope Department of Entomology, University of Oxford, by the initials (HDE). Records are listed for Australian material since information on Australian ichneumonids is rare. The slide preparations of Australian material will be deposited in the Australian National Insect Collections, Canberra, ACT, (ANIC).

In work of this kind, care must be taken to ensure that only reliably identified material is used. I am deeply indebted to Drs. J. F. Perkins and H. Townes for advice on the classification, relationships and nomenclature of the Ichneumonidae, to the U.S. National Museum for providing me with material for study, to the University of Manchester Museum for providing me with a reared specimen of *Schizoloma amictum* (F.), to the New South Wales Department of Agriculture for a reared specimen of *Hetero-*

pelma trichiosoma (Cameron), to the ANIC for a reared specimen of *H. scaposum* (Morley) and to Herr Rolf Hinz of Einbeck, Germany, for a reared specimen of *H. calcator* Wesmael.

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The outstanding larval characters of the Anomalinae are: Mandibles, epistoma, pleurostomae and hypostomae well sclerotized, hypostomal spur reduced or absent, labial sclerite reduced in the ventral region and each stipital sclerite curving dorsally from the labial sclerite to meet the hypostoma. These characters are conspicuously like those of the Metopiinae. The Anomalinae can be distinguished from the Metopiinae only by the reduction or absence of the prelabial setae. The adults of these two subfamilies differ greatly in form.

The larval characters are known for only some genera of the Anomalini, Gravenhorstiini and Theriini of the Anomalinae (Short, 1959, 1970). The Anomalini, so far as known, have teeth on the blade of the mandible. The very broad epistoma and pleurostomae is characteristic of the Theriini and the key given in Short (1959:502) can be revised for the Theriini and Gravenhorstiini as follows:

1. Lateral expansion of pleurostoma and hypostoma extending as a uniformly broad area to lateral end or almost to lateral end of hypostoma Theriini
- Lateral expansion of pleurostoma and hypostoma, if present (*Aphanistes*, *Trichionotus*), not extending as a uniformly broad area to lateral end or almost to lateral end of hypostoma Gravenhorstiini

Tribe Theriini

The species of this tribe are large in form and the adults usually colorful. The hosts are larger moths, particularly those of hairy caterpillars.

Larval Characters.—Epistoma, pleurostomae and hypostomae very broad and extending as a uniformly broad area to lateral ends or almost to lateral ends (*Schizoloma*) of the hypostomae; hypostomal spur absent; stipital sclerite slender and curving dorsally as in other Anomalinae (Short, 1959, 1970); labial sclerite more complete than in Gravenhorstiini but with mid-ventral part lightly sclerotized only in *Tanypelma* (Short 1959, Fig. 63B); maxillary and labial palps discshaped and with 2 sensilla, 1 large and 1 small; silk press lightly sclerotized; prelabial sclerite absent; labral sclerite absent; large sensilla grouped in patterns on clypeo-labral area; setae of maxillae and prelabium absent (*Therion*, *Schizoloma*, *Tanypelma*) or present but much reduced in some species of *Heteropelma*; mandibles large with relatively straight blades which lack teeth; antennae discshaped;

closing apparatus of spiracle lightly sclerotized and adjoining atrium; skin with very small bubblelike projections, and very small setae visible only in *Therion*.

Larval Key to Genera

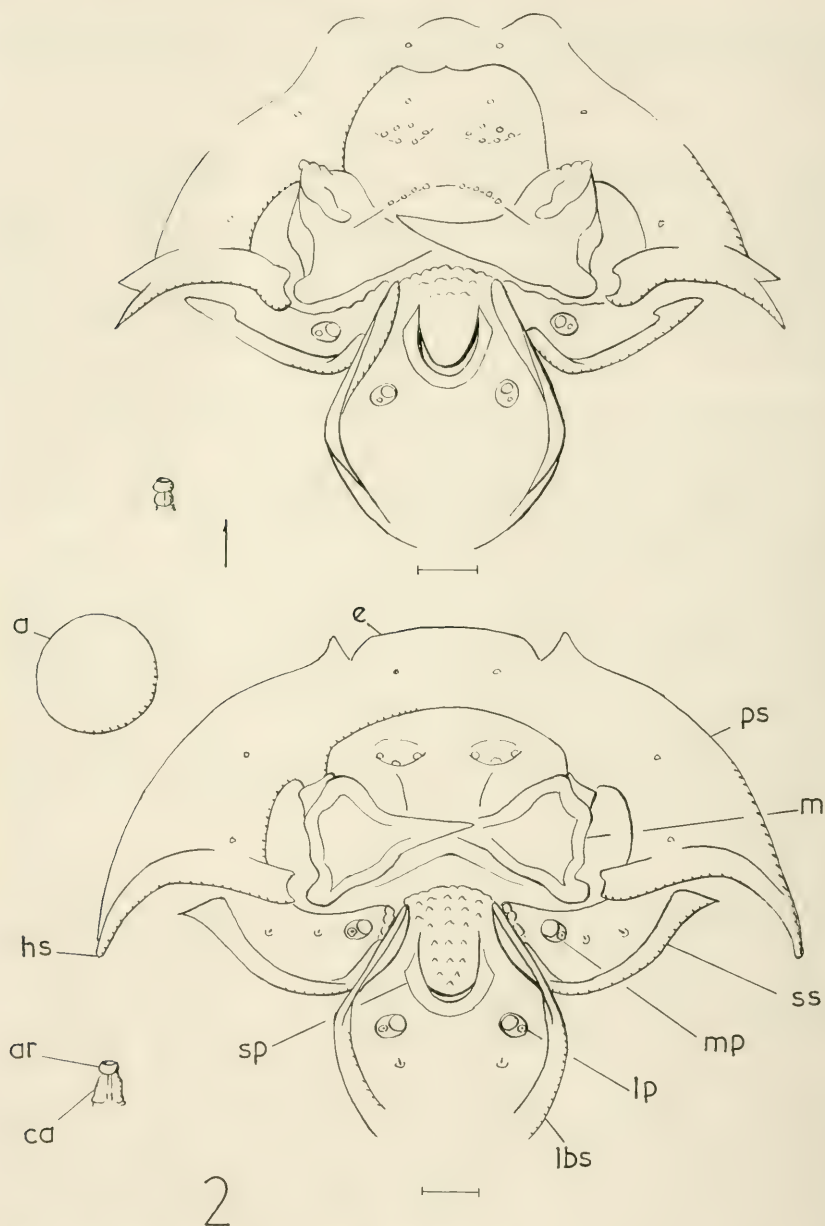
- | | |
|---|--------------------|
| 1. Depth of epistoma approximately $\frac{1}{2}$ width of pleurostoma | <i>Schizoloma</i> |
| – Depth of epistoma greater than $\frac{1}{2}$ width of pleurostoma | 2 |
| 2. Two raised areas on clypeolabrum, each with 1 sensillum | <i>Therion</i> |
| – Two raised areas on clypeolabrum, each with 3 or 4 sensilla | 3 |
| 3. Midventral part of labial sclerite lightly sclerotized | <i>Tanytelma</i> |
| – Midventral part of labial sclerite not lightly sclerotized | <i>Heteropelma</i> |

Material Studied.—*Therion* is a moderately large genus occurring mainly in the Holarctic, Neotropic and Ethiopian regions, and parasitizing many kinds of larger caterpillars; some species specialize in hairy caterpillars, such as Arctiidae. Short (1959, Fig. 63A) figures *Therion circumflexum* (L.) (USNM) and Cushman (1947) figures *T. morio* (F.).

Tanytelma contains two species in eastern North America. The usual host for both species is *Datana* (Notodontidae) (Townes, 1971:157). This genus can be readily distinguished from *Heteropelma* on larval as well as adult characters in that the larval labial sclerite appears complete with the ventral part lightly sclerotized. *Tanytelma fulvicorne* (Townes) (USNM) is figured by Short (1959, Fig. 63B).

Schizoloma amictum (F.) (Fig. 1) (HDE) from *Polia nebulosa* (Hufnagel) (Caradrinidae) has been examined. The locality was Birmingham, Warwickshire, England. Townes (1971:158) places *Schizoloma* under *Heteropelma*. The adults of the species grouped under *Schizoloma* have a median notch in the apex of the clypeus, but there are no other differences between *Schizoloma* and *Heteropelma*. However, the known final instars of *Schizoloma* can be readily distinguished from those known of *Heteropelma* by the form of the epistomal-pleurostomal arch (Figs. 1, 2). *Schizoloma* is therefore retained as a separate genus in the present account.

Heteropelma is a moderate-sized genus of the Palearctic, Indo-Papuan and Australian regions. The hosts are various larger moths. *Heteropelma trichiosoma* (Cameron) (Fig. 2) (ANIC) from an unidentified host was examined. The locality was Beecroft, New South Wales. *Heteropelma scaposum* (Morley) (ANIC) from *Digglesia australasiae* (F.) (Lasiocampidae) was also examined. The locality was Canberra, ACT. *Heteropelma calcator* Wesmael (HDE) is figured by Short (1970). Small setae were noted on the maxillae and prelabium of *H. trichiosoma* and *H. scaposum* but not *H. calcator*. Observation of these setae may be related to the availability of Leitz Ortholux microscope when examining only the first two species.



Figs. 1-2. Each figure illustrates head sclerites and mandibles, antenna (when visible) and spiracle. The scale represents 0.1 mm. 1, *Schizoloma amictum*. 2, *Heteropelma trichiosoma*. Abbreviations: a, antenna; ar, atrium of spiracle; ca, closing apparatus of spiracle; e, epistoma; hs, hypostoma; lbs, labial sclerite; lp, labial palp; m, mandible; mp, maxillary palp; ps, pleurostoma; sp, silk press; ss, stipital sclerite.

Discussion

Of the known larvae of the Anomalinae, the Anomalini, as seen in *Anomalon* (Short, 1959) are distinct in larval and adult structure and in larval habits. The Gravenhorstiini and Theriini, the only other tribes known on larval characters, are similar and clearly related.

Increasing knowledge of the larvae of Anomalinae and Metopiinae increases the difficulty in distinguishing between the larvae of these subfamilies. The couplet in Short (1959:398) keying these subfamilies on the presence or absence of setae on the prelabium is no longer adequate. The maxillary and prelabial setae are better developed in the Metopiinae than in the Anomalinae, but some small setae are present on the prelabium in many species of Anomalinae.

Since the adults of these subfamilies are so different in form, it is doubtful that the similarity of the larvae is due to phyletic relationship. It is argued in Short (1959:502) that the resemblance in larval characters between these subfamilies is due to convergence associated with a similarity in larval habits. In the Anomalinae and Metopiinae, development takes place within the pupa of a lepidopterous host and the cocoon spun is slight. The skeleto-muscular mechanisms involved in spinning the cocoon are known (Short, 1952, 1959). They consist principally of the labial sclerite, the hypostomal spurs and associated muscles. It is reasonable to assume that part of the striking similarity between the larvae of these subfamilies is due to a reduction of the cocoon associated with a reduction of the muscles which evert the dorsal end of the prelabium and a reduction of the labial sclerite and hypostomal spur.

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A NEW SUBSPECIES OF *GLAUCOPSYCHE LYGDAMUS*
FROM CALIFORNIA (LEPIDOPTERA: LYCAENIDAE)

Edwin M. Perkins and John F. Emmel

Abstract.—*Glaucopsyche lygdamus palosverdesensis*, new subspecies, is described.

While residing in the Palos Verdes Peninsula of southern California, the senior author had the opportunity to explore the few remaining, undisturbed seaward canyons and marine terraces that once typified this unique area. Consequently, a series of *Glaucopsyche lygdamus* (Doubleday) was collected during the months of February and March, between the years 1973 and 1976.

In the coastal sage scrub plant community that characterizes this region, the butterflies were never observed to be far from the flowers of a rattleweed or locoweed plant, *Astragalus* L. Given that the northern California Coast Range subspecies, *Glaucopsyche lygdamus incognitus* Tilden, uses several species of *Lupinus* L., whereas *Lotus scoparius* (Nutt.) Ottley is known to be the only host of the cismontane southern California subspecies, *Glaucopsyche lygdamus australis* Grinnell, the authors conducted a search to determine what particular foodplant was being utilized. Although we failed to discover either of these plants where adults flew, subsequent observations confirmed that *in copula* pairs and ovipositing females were always to be found in association with the legume employed as their sole foodplant: *Astragalus trichopodus* (Nutt.) Gray ssp. *leucopsis* (Torr.) T. & G.

Comparison of the Series.—Comprised of adults taken on the wing, as well as individuals reared *ex ova* and *ex larva*. Additional materials borrowed from the Allan Hancock Foundation (University of Southern California, Los Angeles), Allyn Museum of Entomology (Sarasota, Florida), California Academy of Sciences (Golden Gate Park, San Francisco), California Insect Survey (University of California, Berkeley), Los Angeles County Museum of Natural History, and National Museum of Natural History (Smithsonian Institution) confirmed our premise that an unnamed subspecies existed.

Its unique phenotype, habitat, foodplant and flight period attest to wisdom inherent in the old adage: "There is much to be discovered in one's own back yard!"

Glaucopsyche lygdamus palosverdesensis Perkins & Emmel, new subspecies
(Fig. 1)

Male.—Maximum radius of left forewing of the holotype, 15.7 mm.

Upperside: Iridescent blue, with faint greenish-violet hues. Black,

prominent outer margin of forewing continuous from apical area of costal margin to tornus of outer angle; inwardly, outer margin blends imperceptibly with black scaling on M_1 - Cu_2 vein-ends.

Underside: Ground color grayish white. Basal area of hind wing moderately suffused with pale bluish pubescence. Marginal fringe of forewing and hind wing white, interrupted at intervals corresponding to wing veins by black scales, producing checkered effect. Marginal fringe of both wings set off by complete terminal lines that are sharply demarcated. Postmedian row of forewing spots white, accentuated by large, distinct black pupils; postmedian row of hind wing spots proportionally smaller but otherwise similar to those of forewing. Usually 1, well-developed postbasal spot on hind wing. Forewing cell-end bar black, surrounded by white; hind wing cell-end bar faintly black, outlined by white.

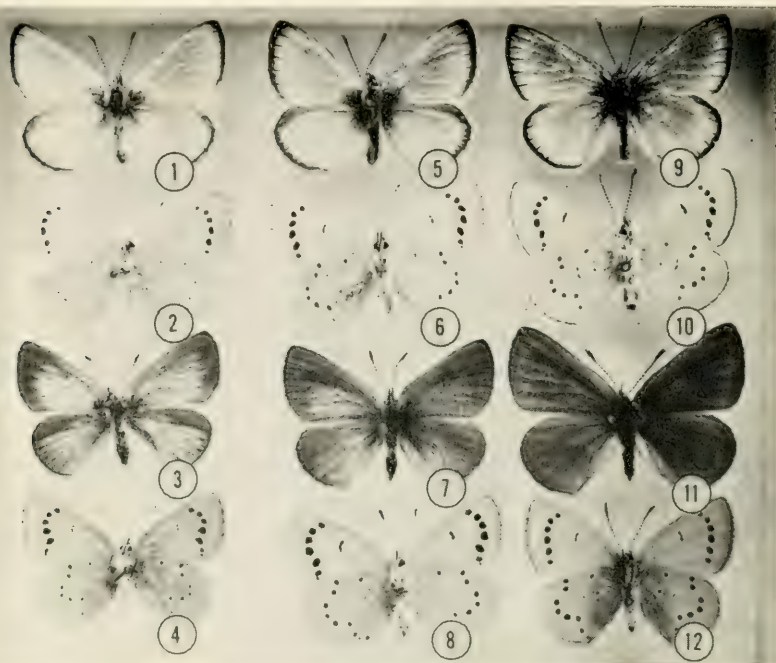
Female.—Maximum radius of left forewing of the allotype, 15.9 mm.

Upperside: Dark gray, with blue iridescent scaling usually confined to discal areas of forewing and hind wing.

Underside: Ground color light grayish tan. Postmedian row of hind wing spots proportionally smaller than those of forewing, but widely ringed with white. Otherwise, similar to male.

Distinguishing Features.—The subspecies *palosverdesensis* is larger than *australis* but smaller than *incognitus* (refer to Fig. 1). The mean left forewing radius of males in each subspecies is 15.75 mm, 15.32 mm and 16.19 mm, respectively, whereas females measure 15.93 mm, 14.98 mm and 16.43 mm, respectively. The darker, richer blue color on the upper surfaces of *palosverdesensis* males resembles that exhibited by *incognitus* males but is unlike the pale bluish luster that characterizes *australis* males. When compared to those of *australis* males, the black outer margins of *palosverdesensis* and *incognitus* males are distinctly darker and more prominent. The dark gray color of *palosverdesensis* females, which is highlighted by blue iridescence that is restricted to the discal areas of the wings above, is also distinctive. In *australis* females, the color is predominantly iridescent blue and is set off by grayish-black scaling along the costal margin, apical and limbal areas of the forewing and costal margin and anal angle of the hind wing. By contrast, *incognitus* females are brown above, with occasional blue scaling confined to the basal areas of the wings only. In both sexes of *palosverdesensis*, the suffusion of white and black scales (in the relative absence of brown scales) produces a chalky gray ground color that is unique. Unlike *australis*, postmedian black spots on the hind wings are larger and better developed in both sexes of *palosverdesensis*; unlike *incognitus*, whose postmedian black spots are also comparably large on both wings, those of *palosverdesensis* are prominently haloed by rings of white.

A detailed study of the entire *Glaucopsyche lygdamus* species-complex, which is to be published by the authors in the near future, precludes the



Figs. 1-4. *Glaucopsyche lygdamus australis*. 1, ♂ above, Baldwin Hills, Los Angeles Co., Calif., 19-II-61, leg. J. F. Emmel. 2, ♂ below, Upland, San Bernardino Co., Calif., 8-IV-57, leg. T. M. Blackman. 3, ♀ above, El Cajon, San Diego Co., Calif., 14-III-59, leg. A. O. Shields. 4, ♀ below, 15-III-59, otherwise, same data as 3. Figs. 5-8. *Glaucopsyche lygdamus palosverdesensis*. 5, ♂ holotype above, Rancho Palos Verdes, Palos Verdes Peninsula, Los Angeles Co., Calif., 24-II-74, leg. E. M. Perkins. 6, ♂ paratype below, 21-II-74, otherwise, same data as holotype. 7, ♀ allotype above, same data as holotype. 8, ♀ paratype below, 23-II-74, otherwise, same data as holotype. Figs. 9-12. *Glaucopsyche lygdamus incognitus*. 9, ♂ topotype above, Alum Rock Park, 6 mi NE San Jose, Santa Clara Co., Calif., 2-IV-60, leg. O. E. Sette. 10, ♂ topotype below, same data as 9. 11, ♀ above, 1 mi W Angwin, Napa Co., Calif., 7-IV-68, leg. R. L. Langston. 12, ♀ below, Twin Peaks, San Francisco, San Francisco Co., Calif., 4-IV-66, leg. N. La Due. All specimens are photographed to scale.

necessity of comparing *palosverdesensis* with other *lygdamus* subspecies at this time.

Holotype.—Male, to be deposited in the Collection of the United States National Museum of Natural History, Washington, D.C. Data accompanying specimen is as follows: Rancho Palos Verdes, Palos Verdes Peninsula, Los Angeles County, California, 800 feet above sea level, 24 February 1974, leg. E. M. Perkins.

Allotype.—Female, to be deposited in the Collection of the United States National Museum of Natural History; bears the same data as the holotype.

Paratypes.—Sixty-seven ♂♂, 34♀♀, collected by E. M. Perkins and J. F. Emmel at the same place as the holotype on dates ranging from 1 February 1973 through 28 March 1976. Thirteen ♂♂, 6♀♀ to be deposited with the holotype and allotype; the remaining paratypes to be distributed as follows: 12♂♂, 5♀♀ (Allyn Museum of Entomology), 12♂♂, 5♀♀ (American Museum of Natural History), 12♂♂, 5♀♀ (California Academy of Sciences), 12♂♂, 7♀♀ (Los Angeles County Museum of Natural History), and 6♂♂, 6♀♀ (to be retained by the authors).

Four additional males (bearing the data: "Collection of John S. Garth, Palos Verdes Hills, Cal., 3-6-28") are also designated paratypes and will be retained in the USC, Allan Hancock Foundation collection, where they were originally brought to our attention by its curator.

Remarks.—The distribution of *palosverdesensis* is exclusively peninsular, being restricted to the cool, fog-shrouded seaward side of the Palos Verdes Hills. This area includes the communities of Palos Verdes Estates, Rancho Palos Verdes, Rolling Hills Estates, Rolling Hills and Portugeuse Bend. Specimens examined from within an eight-mile radius to the north and east agree favorably in phenotype with other populations of *australis*, which inhabit the Los Angeles Basin.

At present, the well-being of *palosverdesensis* is uncertain. The threat of accelerated residential and commercial development points uneasily to the fate of *Glaucopsyche xerces* (Boisduval), another California peninsular endemic—now extinct some thirty-five years!

Acknowledgments

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CARDARIA DRABA (L.), A NEW HOST FOR APHIS ARMORACIAE
COWEN (HOMOPTERA: APHIDIDAE)

Rouhollah Sobhian

Abstract.—This study reports the weed, *Cardaria draba* (L.), as a new host for *Aphis armoraciae* Cowen. The possibility of the biological control of this weed is discussed.

Cardaria draba (L.), an endemic Old World cruciferous plant, is a noxious weed in many countries. Its presence in the United States was first noted in 1898 about the seaports of New York, Washington and elsewhere (indicating introduction from ships' ballast), and it is now a well-established and serious pest on the East Coast, in some central states and on the West Coast (Robbins et al., 1951). Several investigators have searched for host specific natural enemies for possible use in the biological control of this weed. Over 120 arthropod species have been reported to be associated with this plant, but other than *Aceria draba* Nalepa few, if any, of them seem to be specific enough to be employed as a control agent.

Lipa (1974) suggested *Aceria draba*, a monophagous Old World mite, as a possible candidate which could be used as a control agent for *Cardaria draba*. But according to Buhr (1964) and Roivainen (1950) even *Aceria draba* has been reported on five other species of Cruciferae making its use questionable. Thus further host specificity studies are required of this eriophyiid mite before its introduction into the New World. The search for additional natural enemies continues.

Lipa (1974), Hering (1932), Bodenheimer and Swirski (1957), Leonard (1953-1963, 1968) and Patch (1938) did not find *Aphis armoraciae* on *Cardaria draba*. This aphid was first found on *C. draba* May 10, 1976 in Solano County, California, near Fairfield. The weed was abundant, and the aphid was found on the roots down to 3 cm in the soil, sometimes covering most of the root surface to that depth (Fig. 1).

Over 90% of these aphids were parasitized by an aphidiid which is not identified.

The aphid and its parasite were also found in Monterey County (Salinas) and Santa Cruz County (near Watsonville).

Leonard (1953-63) referred to this aphid as the Western aster root aphid. It seems to be native to North America.

Aphis armoraciae has been reported on the roots of *Radicula armoracia* (L.) Robinson (Patch, 1938), *Zea mays* L. (Palmer, 1952), *Rumex obtusifolia* L., *Aster lateriflorus* (L.) Britton, *Aster simplex* Willdenow and *Phlox* sp. (Leonard, 1953-1963).



Fig. 1. Parasitized *Aphis armoraciae* covering the roots of *Cardaria draba*.

In view of the wide host range of *Aphis armoraciae* and its presence on *Zea mays*, this aphid cannot be used as a control agent against *Cardaria draba*.

Acknowledgments

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BEHAVIORAL STUDIES OF THE SLUG-KILLING LARVAE OF
TWO SPECIES OF *TETANOCERA* (DIPTERA: SCIOMYZIDAE)¹

Dennis G. Trelka and Clifford O. Berg

Abstract.—A detailed comparison of attack behavior exhibited by third-instar larvae of *Tetanocera plebeia* Loew and *T. elata* (Meigen) indicated that both species immobilize slugs with a toxic injection. However, larvae of *T. elata* usually attacked the ventral surface of the slug's foot, which caused a more rapid immobilization than attacks of larvae of *T. plebeia*. These latter attacks were directed more often at the slug's posterolateral portion, a site more distant from the apparent site of action of the toxin. An analysis of the searching behavior employed by the predatory larvae of *T. plebeia* indicated that the larvae follow fresh slime trails only after recent contact with a slug, and that they often follow them in the wrong direction.

Relatively few insect-slug relationships have been reported. Stephenson and Knutson (1966) mentioned no insects associated with slugs except beetle larvae of the families Carabidae and Lampyridae and dipterous larvae of the families Phoridae, Sarcophagidae and Sciomyzidae. The Sciomyzidae (Diptera: Acalypttratae) known to utilize slugs as host and prey species during larval life include four species of *Tetanocera* (Foote, 1963; Knutson et al., 1965). In all four species, the young larvae live as parasitoids, intimately associated with slugs for several days before killing them. Young larvae of *T. plebeia* Loew and *T. elata* (Meigen) remain under the mantle of the host, where they apparently subsist on proteinaceous secretions during the first larval stadium and begin to feed on slug tissues after their first larval molt. Shortly before or about at the time of the second and final larval molt, the original slug host dies, and larvae of all four species change to a predatory way of life. After this change, they kill and feed quickly and usually abandon each victim in less than an hour (Trelka and Foote, 1970; Knutson et al., 1965).

Although each larva normally kills only one slug during its first two stadia, each third-instar larva commonly kills several additional slugs. Coincident with the change from parasitoid to predaceous food habits, larvae of *T. plebeia* and *T. elata* also change from relative host-specificity to considerably less selectivity in their utilization of molluscan food resources. Both are confined to feeding on *Deroceras* (= *Agriolimax*) *laevis* (Müller) and *D. reticulatum* (Müller) during their parasitoid stadia, but the predatory third-instar larvae of both utilize slugs of other genera, and larvae of *T. plebeia* have even been found feeding in nature on terrestrial snails

(Trelka and Foote, 1970; Knutson et al., 1965). Slugs attacked by third-instar larvae of both species are quickly immobilized. This rapid loss of locomotor function in slugs attacked by larvae of *T. plebeia* is caused by a neurotoxic salivary secretion injected by the larvae (Trelka and Foote, 1970). Although the larvae of *T. plebeia* and *T. elata* have many behavioral characteristics in common, the most thorough previous study of *T. elata* (Knutson et al., 1965) includes no mention of a neurotoxic substance utilized by the larvae.

This study was undertaken to investigate: (1) the comparative attack behavior of third-instar larvae of *T. plebeia* and *T. elata*, (2) the effects produced on slugs by larval attacks, (3) whether these effects are perceptibly different when different points of the slug body are attacked, (4) whether larvae of *T. elata* also produce and utilize neurotoxic salivary secretions, and (5) whether predatory larvae of *T. plebeia* can utilize slime trails to track slugs.

Materials and Methods

Rearing Techniques.—Field-collected slugs (*Deroceras laeve* and *D. reticulatum*) were placed in covered plastic containers (31 cm $\times$ 25 cm $\times$ 11 cm) that had 2 holes (4.5 cm diameter and covered with wire screening) cut in the top and in each of the longest sides. The bottom of each of these rearing chambers was covered with a double layer of moistened paper towelling. Each chamber was provided with a plastic container (16 cm $\times$ 10 cm $\times$ 3 cm) filled with sterile soil, and another plastic container (8 cm $\times$ 4 cm $\times$ 1 cm) filled with oat flakes, pieces of fresh carrot and fresh lettuce.

Each chamber could support a population of approximately 75 slugs for 6–10 months. They were kept in the dark at 5–8°C. Decayed lettuce, decayed carrots, mold-covered oat flakes and dead slugs were removed daily. Every 2 days the inside top and sides of the chamber were wiped clean of fecal matter. The rearing chambers were cleaned, and new paper and fresh soil were added every 2 weeks.

Slug eggs were collected from the chambers weekly; approximately 100 of them were placed in petri dishes (5.5 cm $\times$ 1.5 cm) on moist filter paper and incubated at 12–15°C under long-day conditions (14 h day). After the eggs hatched (13–18 days), oat flakes were placed in with the young slugs. When the slugs were about 2 weeks old, they were placed in adult rearing chambers in the dark at 5–8°C.

Field-collected adults of *Tetanocera plebeia* were placed in breeding jars (described by Trelka and Foote, 1970); fresh moss leaves served as oviposition sites. Eggs were collected with a moist camel's hair brush, were transferred to moist filter paper in a petri dish (5.5 cm $\times$ 1.5 cm) and were incubated at 19–21°C under long-day conditions (14 h day).

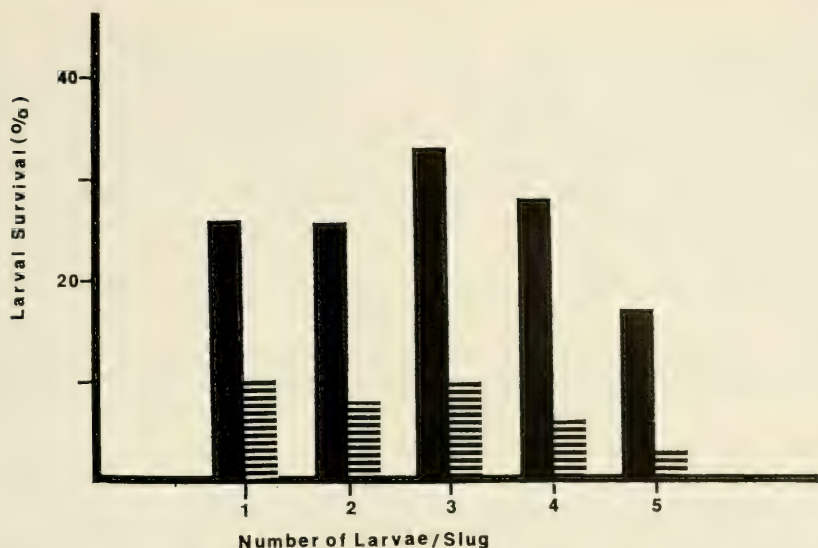


Fig. 1. Larval survival rates, with 1, 2, 3, 4, or 5 larvae placed on each slug. Solid bar, *Deroceras laeve*; striped bar, *D. reticulatum*.

First-instar larvae were picked up with #1 insect pins and carefully placed on the mantles of host slugs (*D. laeve* or *D. reticulatum*). Initially both species were infested with 1, 2, 3, 4 or 5 first-instar larvae. Figure 1 illustrates the results of these infestations, which were based on the percent of first-instar larvae that developed into the third stadium. The highest larval survival rate appeared to occur when 3 first-instar larvae were used to infest *D. laeve*, but this rate was not significantly different from those recorded from *D. laeve* infested with 1, 2, or 4 larvae. Time spent collecting slugs in the field and caring for infested slugs in the laboratory also were important considerations. Therefore, the maximum yield occurred when *D. laeve* was used as the host slug and 3 first-instar larvae were placed on each mollusc. When 5 larvae/mollusc were applied, the yield decreased because of an increase in slug deaths. To avoid cannibalism, each infested slug was kept in an individual petri dish (5.5 cm $\times$ 1.5 cm).

Experimentation.—Each third-instar larva used in this study had attacked and fed upon at least one slug since it entered the third stadium but had not fed for a 24–36 h period prior to experimentation. The larvae were usually hungry and eager to attack slugs. All slugs utilized as prey were *D. laeve* or *D. reticulatum* measuring 15–20 mm in length (while extended in normal movements) and weighing 62–125 (102 ± 9) mg (mean $\pm$ SD). Detailed observations were made with a dissecting microscope while the subjects were on moist filter paper. All investigations were conducted at 21–25°C.

The description of an attack on a slug by a third-instar larva is based on the observations of 25 attacks. A larva was placed in front of a moving slug so that the slug would make initial contact with the larva. This method usually stimulated the larva to attack. If the slug's movement carried it past the larva, the larva was prodded gently with forceps to generate enough movement to intercept the slug. If a larva was removed after an attack of only 5–10 sec, the slug usually recovered from the effects of the toxic injection. The time necessary for recovery (i.e., a return of locomotor function) seemed directly correlated with the duration of attack.

To investigate further the relationship between length of attack and time required for immobilization and recovery, larvae were permitted to attack the posterolateral portion of the slug for periods up to 2 min. Attack periods were considered to begin when the mouthhooks were inserted. This experiment was undertaken to establish a reference to which other data could be compared. Usually a slug attacked by a larva for 1 min or more did not recover, but approximately 30% and 60% of the slugs recovered after attacks of 45 sec and 30 sec, respectively. Slugs attacked for 15 sec usually recovered, and this period of attack was considered the most useful in evaluating the short-term effects produced on slugs under these "controlled" conditions. An attack of 15-sec duration produced a relatively rapid immobilization (60.5 ± 10 sec) and a reasonable recovery time (54 ± 12 min).

Variation in time to immobilization and time to recovery, based on the sites of attack, were also investigated by permitting third-instar larvae to attack slugs at three different sites for periods of 15 sec. At the beginning of these attacks, the larvae were held gently with forceps so that their anterior ends were directed at the desired attack sites. The sites included: 1) posterolateral, 2) posterodorsal and 3) posteroventral. Attempts were made to attack the same site within 2–3 mm, although this was not always possible. The time to immobilization and to recovery were recorded for 5 attacks at each site in one day, and this was repeated on 3 additional days. Therefore, results of the effects of 20 15-sec larval attacks were investigated for each site.

Behavioral studies similar to those used for *T. plebeia* were conducted on larvae of *T. elata*, a Palearctic species. Two gravid females of *T. elata* were received from J. W. Stephenson, Rothamstead Experimental Station, Harpenden, Herts, England. Eggs from these two females provided more than 50 third-instar larvae used in this study.

Third-instar larvae of *T. plebeia* were tested for their ability to utilize the slime trails left behind by moving slugs, which consist of a proteinaceous mucus secretion 2–3 mm in width, probably secreted from mucocytes on the sole of the foot (Campion, 1961). Two experiments were con-

ducted; in both of them normal and supernormal trails were used. The supernormal stimulus was made by painting the mucus taken from the ventral surface of 2-3 slugs on top of a normal fresh slime trail with a camel's hair brush. The amount of mucus in the supernormal stimulus was approximately equivalent to twice the normal stimulus and usually extended to about 2 cm in length. In one investigation, larvae were made to approach a fresh slime trail (10-20 sec old) from a distance of 5 mm at a 90° angle, and their response upon making contact with a trail was recorded. In the other test, larvae were placed directly onto and parallel with fresh slime trails, with equal numbers placed in the direction of slug movement and in the opposite direction. Investigations were conducted with recently rehearsed larvae (larvae that had contacted slugs within 30 sec of the test) and with larvae that were unrehearsed.

Results

The attack of a slug by a third-instar larva of *T. plebeia* usually followed a predictable sequence of events. During the first period (1-10 sec), the larva seemed to "test" the slug's mucus, by placing its anterior 2 segments in contact with the slug and quickly removing them. This behavior usually was repeated 3-5 times and was not restricted to specific areas on the slug's body. The larva would then insert its mouthhooks into the posterior half of the slug at a point 2-3 mm above the foot. No slashing movements or repeated insertions of the mouthhooks were observed. In the second period (10-60 sec), the slug attempted to free itself from the grasp of the larva by rapid side-to-side movements of the posterior end of its body, by attacking the larva with its mouthparts, or by moving rapidly in a forward direction pulling the larva along. As the slug was dragging the larva (as much as 10 cm in some instances), the mollusc slowed, secreted abnormal amounts of mucus, appeared to quiver and became incapable of further forward motion. During this same period, the larva remained essentially motionless except for what appeared to be the action of a salivary pump in its anterior end. The anterior end of the slug's foot was lifted slightly off the substrate, and a view from the ventral side through a glass plate showed that the locomotor waves on the center strip of the foot decreased in frequency until they were no longer visible. After immobilization, the slug continued to extend its head and eye tentacles rapidly, apparently in an attempt to move forward. This ineffective effort may account for the quivering motion observed. In the third period (1-4 min), the slug was completely helpless. The larva removed its mouthhooks, crawled slowly onto the slug's anterior end and began to feed. In about 30% of the encounters observed, the larva withdrew its mouthhooks and lay motionless parallel to and contiguous with the paralyzed slug for 1-2 min before feeding. Feeding usually lasted 10-60 min.



Fig. 2. Time lapse to immobility (solid bar) and to recovery (striped bar) after 15-sec attacks by larvae of *Tetanocera plebeia* on dorsal (D), lateral (L), and ventral (V) surfaces of slugs.

Larvae that had fed recently (within 1–2 h) and larvae that were about to form their puparia attacked and immobilized slugs but usually failed to feed on them. Most slugs that were attacked but not fed upon died within an hour.

Numerous slugs were pricked with a pin or injected with 25 μ l of distilled water to stimulate a larval attack, but none of the slugs tested became immobilized. Both experiments actually caused an increase in locomotion.

Figure 2 illustrates the relationship between sites attacked and time to immobility, and between sites attacked and time to recovery, when slugs were attacked by third-instar larvae at 3 different sites for 15 sec. There was a significant difference between the times to immobility from larval attacks at three different sites (posteroventral, 31 ± 7 sec; posterolateral, 60 ± 9 sec; posterodorsal, 107 ± 15 sec) when the data were analyzed by Duncan's multiple-range test (Duncan, 1955). A similar analysis showed that recovery time from ventral attacks (148.3 ± 17 min) was significantly different from the recovery time from dorsal (34.5 ± 10 min) and lateral attacks (54.3 ± 13 min), but there was no significant difference between recovery periods from lateral and dorsal attacks. Analyses of variance of the time to immobility and time to recovery showed significant differences ($P < 0.005$ for both periods) between the different sites of attack, but no significant differences between the different test days nor the interaction between test days and sites ($P > 0.25$ for all).

The normal crawling behavioral pattern exhibited by third-instar larvae consisted of movement in relatively straight lines with an occasional stop

Table 1. Comparison of attacks of *Tetanocera elata* and *T. plebeia* and of their effect on slugs. The data for each species are based on samples of 20 third-instar larvae, and time periods given all start at first insertion of mouthhooks. All values given are in seconds.

	Usual site of attacks	Time required for immobilization with attacks at usual sites, mouthhooks inserted for entire period	Time elapsed until feeding was initiated	Time required for immobilization after 15-sec attacks at postero-lateral site
<i>T. elata</i>	anteroventral part of foot	5-30 (15 ± 3.2)	15-60 (35 ± 4)	55 ± 9.4
<i>T. plebeia</i>	posterolateral part of body	15-120 (54 ± 9.8)	60-240 (174 ± 30)	60 ± 10

during which time the larvae remain motionless for 5-20 sec. Only 2 out of 30 larvae changed direction after the brief stop, and those changes were only about 45° to the right or left. They crawled by alternate contraction and extension of body segments, which gave the appearance of peristaltic waves that passed over the body from the posterior to the anterior end. The mouthhooks and creeping welts were used for anchorage. This means of locomotion is common to other Diptera larvae (Hewitt, 1914). The mouthhooks were thrust out laterally from side to side, usually at a distance of no more than the maximum width of the larva. The larva may receive gustatory stimuli from slime trails during anchorage of the mouthhooks.

The behavior of *T. elata* appeared almost identical to that recorded for *T. plebeia* during the first and second larval stadia (Trelka and Foote, 1970), but somewhat different during the third. Out of 20 larval attacks by *T. elata*, 18 of the mature larvae approached the slug from the posterior end but attacked the anterior end. Fifteen of those 18 attacked at the ventral surface (locomotor strip). One of the two larvae that did not attack the anterior end attacked the posteroventral surface of the foot; the other attacked posterolaterally. The three larvae that attacked anteriorly but not ventrally attacked the head area of the slug (usually between the eye tentacles). Larvae were never observed slashing the head area with their mouthhooks to immobilize a slug. The larvae inserted their mouthhooks into the slug, held them in place and appeared to inject a toxin. The slugs quickly became immobile and no longer produced locomotor waves.

Although third-instar larvae of both species utilize a toxic secretion, their selection of sites of attack and the times to initiation of feeding behavior were different (Table 1). The larvae of *T. elata* appear to concentrate their attack on the anteroventral surface of the slug's foot, whereas the larvae

of *T. plebeia* seem to select the posterolateral portion of the slug most frequently. Feeding behavior was initiated much sooner in *T. elata* (35 ± 4 sec) than in *T. plebeia* (174 ± 30 sec). Although the general effect on slug locomotion is similar, the ventral attack of *T. elata* caused immobilization more quickly.

To determine whether the rapid immobilization caused by larvae of *T. elata* results primarily from their choice of a very effective site of attack, ten larvae of *T. elata* were held so that they could attack only the posterolateral portion of slugs for a 15-sec period. The times to immobilization of slugs were not significantly different when attacks of the two species were confined to the same site and the same length of time (Table 1).

The results of tests designed to investigate the ability of larvae to recognize and or follow slime trails are listed in Table 2. Table 2 illustrates the responses of larvae after they made contact with a slime trail approached at angles approximating 90° . Some unrehearsed larvae showed weak responses to normal and supernormal slime trails, but most of them indicated no perceptible response. There was a difference of some significance ($P < 0.002$) in the responses of recently rehearsed larvae to normal and supernormal trails. Although their responses to trails of both types were significantly greater than those of unrehearsed larvae, these responses were of no apparent benefit to the larvae. Most recently rehearsed larvae stopped at the trail and appeared to test it with their anterior ends in a manner similar to that exhibited when they contacted a slug. However, most of these larvae crawled away after 5–15 sec in the same direction they were traveling previously. A small percentage of the recently rehearsed larvae resumed travel, but in a new direction, at an angle of at least 45° left or right (the mild response referred to in Table 2). No larvae turned 90° , and none followed a slime trail, so this response was not effective in guiding any larvae to a slug.

Table 2 also illustrates that the responses of unrehearsed larvae differ significantly ($P < 0.001$) from those of recently rehearsed ones when placed onto either normal or supernormal trails. No significant difference was found between the responses of either unrehearsed or recently rehearsed larvae to normal versus supernormal trails. One-third of the recently rehearsed larvae followed the normal trails, but about half of these followed in the wrong direction (in the direction opposite to slug movement). A larva following a slime trail increased the frequency of the lateral movement of its mouthhooks and usually increased the speed of locomotion. When it came to the abrupt end of the trail, it thrashed out with its anterior end, continually making what appeared to be small circular searching motions (3–4 mm in diameter) for 15–20 sec. By contrast, larvae that were not tracking slugs but just happened to crawl across or along a slime trail usually continued the typical locomotor behavior (described above) upon

Table 2. The responses of unrehearsed and recently rehearsed larvae (in the third stadium) that approach and contact slime trails at a 90° angle (top figure), and of larvae placed on fresh slime trails (bottom figure).

	No. larvae tested	No response ^a	Weak response ^b	Mild response ^c	Strong response ^d	<i>P</i> <
Unrehearsed larvae	30	25	5	0		0.001
(normal trail)	30	26	4		0	0.001
Recently rehearsed larvae	30	10	18	2		
(normal trail)	30	2	18		10	
Unrehearsed larvae	15	12	3	0		0.001
(supernormal trail)	15	12	3		0	0.001
Recently rehearsed larvae	15	2	7	6		
(supernormal trail)	15	0	7		8	

^a No response—after making contact with trail, larvae continued normal crawling behavior in same direction.

^b Weak response—after making contact with trail, larvae stopped (5–15 sec), tested trail, then continued crawling in same direction.

^c Mild response—after making contact with trail, larvae stopped, tested trail, turned at least at an angle of 45°, left or right and resumed crawling but in a new direction.

^d Strong response—after making contact with trail, larvae followed trail (but often in wrong direction).

reaching the end of the trail. This behavioral difference when the end of the trail was reached made it quite easy to distinguish the larvae that were following slime trails.

All tests of significance were based on the *t*-test, and a value of $P < 0.001$ was used as a minimum for levels of significance unless otherwise noted.

Discussion

Toxic immobilization of slugs by larvae of *T. elata* probably was overlooked by Knutson et al. (1965) partly because the paralyzing effects of the neurotoxic salivary secretion of *T. elata* occur so rapidly (15 ± 3.2 sec) and partly because this phenomenon was completely unknown and unexpected among sciomyzid larvae. What those writers interpreted as an attack that "lacerated the nervous tissue" probably was the start of larval feeding behavior after the slug was immobilized.

Three possible reasons why immobilization of slugs by *T. elata* was more rapid than by *T. plebeia* seemed to warrant investigation: 1) the injection of a more potent toxin, 2) the injection of more toxin attack, and 3) the site of attack being closer to the site of action of the toxin. The effects produced by 15-sec posterolateral attacks by larvae of both species (Table 1) showed no significant difference in the time to immobilization recorded for the two species. This suggests that *T. elata* neither injected more toxin nor a

more potent toxin. On the other hand, larvae of *T. plebeia* that attacked posteroventrally immobilized slugs significantly faster (in one-half the time) than larvae of the same species that attacked posterolaterally or posterodorsally (Fig. 2). Glowworm larvae also immobilize slugs more effectively when they attack the foot (Schwalb, 1960).

Since the major visible effect of the toxin injection is the cessation of locomotor waves on the ventral surface of the slug's foot, larvae that attack ventrally probably inject the toxin closer to its site of action. Injection of any foreign substance into a slug probably initiates processes of dilution, of uptake by the nephridium or midgut gland ("liver") (Ghose, 1964), and of attack by phagocytic amoebocytes (Tripp, 1961). Therefore, any immobilizing toxin injected remote from its site of action should be expected to require more time for immobilization and to permit the victim to recover more rapidly (Fig. 2).

Satiated third-instar larvae of *T. plebeia* are negatively phototactic. Unless stimulated by a slug, they tend to crawl under moist filter paper in a petri dish and remain relatively motionless. On the other hand, hungry larvae of *T. plebeia* appear to search for slugs in a slow, random fashion. They can usually survive 5-8 days without a meal. Hungry larvae seemingly ignored fresh slime trails until after contact was made with a slug. After a quick contact that presented no opportunity for attack, the larvae appeared to be more aware of fresh slime trails and followed them in some cases. After contact with slugs, or after larvae followed nonproductive trails, the larvae appeared to search vigorously and to circle. If they were unable to locate other slugs or fresh trails, they would lift their anterior ends and strike out forwardly or laterally while their posterior segments were fixed to the substrate, as in the behavior described by Chandler (1969) as "casting."

The apparent need for contact to stimulate active searching behavior is relatively common in predatory insects that react to a gustatory stimulus or "contact chemoreception" (Hodgson, 1958). Study of coccinellid larvae (Banks, 1957; Hagan, 1962) and of syrphid larvae (Chandler, 1969) disclosed that these predatory larvae require contact with prey before a search pattern is activated. Prey movement seems not to play any role in evoking attack or feeding behavior in *T. plebeia*.

Contact with a slug by a larva at a specific motivational level due to hunger appears to initiate searching behavior. When this occurs, a pattern of behavior appears to be released, the direction of which depends on the next incoming stimulus, and then on the next, etc. For example, after a larva comes in contact with a slug and recognizes it as a prey species, the larva can: 1) attack the slug, immobilize it and then feed upon it, 2) find and follow the slug's trail after a quick contact that presented no attack opportunity, overtake it and repeat 1 above, or 3) find and follow the slug's

trail for a short distance, lose the track, circle, and "cast" for 15–30 sec. After a 3–5 min inactive period the larva will not respond to another fresh slime trail. In fact, it behaves like an unrehearsed larva. Unrehearsed larvae show a weak response to supernormal slime trails, but the threshold to slug mucus appears much lower in the recently rehearsed larvae. Glow-worm larvae and the slug *Limax maximus* also are known to follow slime trails, the latter for purposes of mating (Schwalb, 1960; Gelperin, *in litt.*).

The searching behavior after contact with a slug is somewhat variable and dependent on the next external stimulus, but the behavior is relatively stereotyped when the slug is attacked, immobilized and fed upon. If terms commonly used in vertebrate behavior studies are applied to insect behavior, as Baerends (1959) has suggested, these behavioral patterns would be referred to as appetitive and consummatory behavior, respectively. This dichotomy of behavior is not so distinct as that proposed by Lorenz (1960), but is more like that suggested by Lehrman (1953), in which exogenous factors (the environment) and endogenous factors (genetics) affect all behavioral phenomena to some degree. Therefore, the differences in behavioral patterns result from different ways in which external and innate factors interact with one another (Marler and Hamilton, 1966).

The success of a predator, according to Holling (1961), depends on five factors: 1) the abundance of the prey species, 2) the size of the predator population, 3) environmental influences, 4) the behavior and adaptations of the prey and 5) the behavior and adaptations of the predator. This study was focused on Holling's last factor, with some attention also being given to his fourth. It has led to four conclusions of particular interest and significance concerning the behavior and adaptations of third-instar larvae of slug-killing species of *Tetanocera*. (1) The production and use of a neurotoxic salivary secretion is just as characteristic of the larvae of *T. elata* as of those of *T. plebeia*. (2) The site attacked by the larvae evidently influences the time required to immobilize slugs. (3) Apparently for this reason, larvae of *T. elata* immobilize slugs more quickly than larvae of *T. plebeia*. (4) The larvae appear to follow fresh slime trails only after recent contact with a slug, and they often follow them in the wrong direction.

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Footnote

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BOOK REVIEW

Last of the Naturalists: The career of C. Hart Merriam. 1974. By Keir B. Sterling. 478 pp., 25 photographs, frontispiece of 2 drawings. Arno Press, New York, N.Y. \$23.00.

Entomologists with a historical bent will be interested in this book because C. Hart Merriam (1855–1942) was the first Director of the Bureau of Biological Survey, U.S. Department of Agriculture, in which a modest amount of entomological research occurred, such as work by W. L. McAtee on the food habits of Nearctic birds, and reports by C. V. Riley and others on insects taken by the Death Valley Expedition in 1891. However, the Bureau's emphasis was on faunal surveys of mammals and birds, and its functions eventually were reorganized in the current Fish and Wildlife Service, Department of Interior.

We also remember Merriam for his Life Zone theory, based especially on fieldwork done in 1889 at San Francisco Mountain, Arizona. He recognized life zones correlated chiefly with temperature differences at various altitudes. Much of the theory still is regarded as essentially sound, though factors other than temperature are now known to be important, and there have been other modifications.

The author, now in the Department of Social Sciences, Pace University, Pleasantville, N.Y. and an historian by profession, who also is much interested in natural history, pursued the career of Merriam many years for a thesis in history. Now in book form, the result is fascinating reading and is loaded with historical information on numerous leaders in biology and the organizations which they served, for instance—Theodore Roosevelt and his relations with biologists of his period; the early growth of several bureaus of the U.S. Department of Agriculture and the thorny problems of securing adequate Congressional funding; and the pioneer government land surveys in the West and resulting natural history collections. The privately organized Harriman Alaska Expedition, 1889, which resulted in several papers on insects, is described in detail. In this endeavor Merriam played an important part.

Documentation is very good, but there is no index. The photographs add much to the colorful story of this outstanding biologist whose first expedition took him to the Yellowstone region when he was 16 years old. Living off the country in bad weather and sometimes surrounded by Indians of uncertain disposition were 2 factors which prevented the experience from becoming dull. He was a memorable, often controversial figure remembered by some mammalogists for the numerous "species" of grizzly bears which he named.

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NOTE

CORRECTIONS TO "J. DOUGLAS HOOD: BIBLIOGRAPHY OF
SCIENTIFIC PAPERS, CHIEFLY ON THRIPS, AND
INDEX OF NEW NAMES, 1948-1960"

C. F. Jacot-Guillarmod, Albany Museum, Grahamstown, Republic of South Africa, kindly called my attention to two titles I omitted from "J. Douglas Hood: Bibliography of scientific papers, chiefly on thrips, and index of new names, 1948-1960," (Proc. Entomol. Soc. Wash. 76(3):297-309, 1974) and the resultant misnumbering of Hood's last three papers. I omitted Hood's article "Thysanoptera" that appeared in the 1947-1964 printings of the 14th edition of *Encyclopaedia Britannica* and in the remaining printings of this edition, through 1973, in a shorter and slightly revised form. Hood did not assign a number to this article. Also I omitted Hood's paper "The terms tergum and sternum, tergite and sternite," (1958. Systematic Zool. 7(3):131-133) which, according to Jacot-Guillarmod, Hood numbered 174. Thus his paper no. 175 was "A note on *Monilothrips kempfi* Moulton (Thysanoptera: Thripidae)" by J. Douglas Hood and C. Jacot-Guillarmod (1959. J. Entomol. Soc. S. Africa 22(2):489-493) and his paper no. 176 was "Six new Thysanoptera from Brazil," (1960. Rev. Brasil. Entomol. [Sao Paulo] 9:57-68.) No reprints of Hood's paper no. 174 and the *Britannica* article are available. However, through the courtesy of Mrs. Helen Hood Smallridge and Mrs. Robin Hood Jansen the Systematic Entomology Laboratory has the remaining supplies of Hood's reprints for distribution to interested thysanopterists.

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NOTE

THE SQUASH AND GOURD BEES, *PEPONAPIS AZTECA* HURD AND
LINSLEY AND *XENOGLOSSA GABBII CRAWFORDI* COCKERELL IN
CHIHUAHUA, MEXICO (HYMENOPTERA: APOIDEA)

Chihuahua is the largest state in Mexico and its northern boundary is contiguous throughout with the United States, yet its apoid fauna is rather poorly known. Thus, of the 17 species of squash and gourd bees of the genera *Peponapis* Robertson and *Xenoglossa* Smith known from Mexico, Hurd and Linsley (1966. Ann. Entomol. Soc. Amer. 59:835-851; 1967, loc. cit. 60:988-1007) were able to list just two species each of *Peponapis* and *Xenoglossa* for Chihuahua, while for the geographically adjacent and

ecologically less diverse state of Sonora, they listed seven species of the former and three of the latter. Published statements of ranges for several other species in these two genera suggest that they should eventually be found in Chihuahua. The purpose of this paper is to record two such species for Chihuahua.

On the morning of 16 September 1976 I collected from domestic squashes and gourds (*Cucurbita* spp.) growing about a dwelling on a homestead at Milpillas, Chihuahua (ca. 27°13'N, 108°38'W, 6,000'). There I took one male and two females each of *Peponapis azteca* Hurd and Linsley and *Xenoglossa gabbii crawfordi* Cockerell from open blossoms between 0545 and 0650 Mountain Standard Time (sunrise behind clouds at 0716; first sun on blossoms at 0733). These records are of interest because they constitute the first for these two species for the state of Chihuahua, and further, because the record for *P. azteca* is the northernmost recorded for that species.

The specimens cited herein will be deposited in the collection of the Section of Faunistic Surveys and Insect Identification of the Illinois Natural History Survey at Urbana, Illinois. Thanks are due to Dr. Juan M. Mathieu, Instituto Tecnológico de Monterrey, Escuela Superior de Agricultura, Ciudad Obregon, Sonora, and Dr. Francisco Pacheco and Ing. M. Samuel Muñoz Burgos, Centro de Investigaciones Agrícolas del Noroeste, Ciudad Obregon, for considerations which made possible the collection of these bees from a relatively inaccessible region of Chihuahua and for their boon companionship on the trip. Thanks are also due to Dr. Wallace E. LaBerge, Illinois Natural History Survey, for verifying the determinations of the bees, and to Dr. George L. Godfrey, also of that institution, for reading a version of this paper.

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SOCIETY MEETINGS

833rd Regular Meeting—May 6, 1976

The 833rd Regular Meeting of the Entomological Society of Washington was called to order by President Steyskal at 8 P.M. on May 6, 1976 in the Lecture Room of the National Museum of Natural History. Sixteen members and 5 guests were present. The minutes of the previous meeting were read and approved.

Membership Chairman Kingsolver read for the first time the names of the following new applicants for membership:

W. Threlfall, Department of Biology, Memorial University, St. Johns, Newfoundland, Canada.

Jose A. Mari Mutt, Department of Entomology, University of Illinois, Urbana, Illinois.

President-elect Maynard Ramsay discussed details of the annual banquet and encouraged those who have not purchased tickets to do so.

Curt Sabrosky reported on developments concerning the International Congress of Entomology. Applications are coming in steadily. Canadian visitors are not expected to come in numbers because of governmental financial restrictions.

President Steyskal reported on a recent Executive Committee Meeting. The Committee agreed to support a special publication on the history of the Society to be written by Ashley Gurney and to be distributed to all members of the forthcoming Congress. The Committee also proposed a change in the bylaws to allow the editor to increase the size of the publication committee. The proposal, to be voted on at the October meeting, was to insert the words "at least" into Article 7, Section 4, in front of the words ". . . three appointed members.", where the article now reads ". . . The publication Committee shall consist of the Editor as Chairman and three appointed members."

Ted Bissell displayed a copy of the book "Insects that feed on trees and shrubs." Ashley Gurney showed pictures of some older entomologists and equipment they used (ca. 1893). Dr. Gurney also showed 9 pictures of John D. Smith, now in the Society's files, and discussed Smith's career. Lou Davis offered some 17-year cicadas in alcohol. Helen Sollers-Riedel announced that Sir R. S. Christophers, noted English culicidologist, is still alive and healthy at 103 years of age, contrary to an earlier report. John Kingsolver, while trying to update our list of Emeritus members, received and read to the group an interesting letter from Richard P. Cotton, who said he joined the Society as early as 1921. President Steyskal read a paper by Rohwer out of the 1927 Annals of the Entomological Society of America on the taxonomic needs of that day. Rohwer stated the need for mono-

graphic revisions rather than piecemeal species descriptions. Mrs. R. E. Snodgrass mentioned that "Meditations of a Cockroach" by R. E. Snodgrass was read to a Senior Citizens group and was well received.

The principal speaker of the evening was Dr. John Harshbarger of the Department of Invertebrate Zoology, Smithsonian Institution, who gave an informative talk on the physiology of neoplasm and tumors in insects. The talk was well illustrated with Kodachrome slides. A lively discussion period followed the talk.

The meeting was adjourned at 9:35 P.M.

Refreshments were served following the meeting.

Gary Hevel, *Recording Secretary*

834th Regular Meeting—June 2, 1976

The Entomological Society of Washington and Insecticide Society of Washington Joint Banquet was held on June 2, 1976, at the Chief Petty Officer's Club, Washington Navy Yard. The evening began with cocktails and was followed by a buffet.

Archie Geiser was Master of Ceremonies; Victor Adler was host. The main speaker of the evening was Allen L. Steinhauer, Department of Entomology, University of Maryland. Dr. Steinhauer spoke on the "Mexican-Indian Wars" relating the history of controlling the Mexican Bean Beetle (*Epilachna varivestis* Mulsant) with the Indian eulophid wasp *Pediobius foveolatus* (Crawford). Afterward, Maynard Ramsay held a drawing for the door prizes, of which there were many.

Gary Hevel, *Recording Secretary*

835th Regular Meeting—October 7, 1976

The 835th Regular Meeting of the Entomological Society of Washington was called to order by President Steyskal at 8:05 P.M. on October 7, 1976, in the Ecology Theater of the National Museum of Natural History. Twenty-one members and 6 guests were present. The minutes of the previous meeting were read and approved with corrections.

Membership Chairman Kingsolver read for the first time the names of the following new applicants for membership:

Charles M. Cooper, USDA Sedimentation Laboratory, Oxford, Mississippi

Leonard Dureseau, Jr., Vegetables Laboratory, Beltsville, Maryland

Bella S. Galil, American Museum of Natural History, New York, New York

Abdill Hamid, Biological Sciences, University of Lagos, Yaba, Lagos, Nigeria

Michael D. Hubbard, Laboratory of Aquatic Entomology, Florida A&M University, Tallahassee, Florida

Michael E. Irwin, Agricultural Entomology, University of Illinois, Urbana, Illinois

Peter E. Johnson, Entomology Section, University of Wyoming, Laramie, Wyoming

Lester L. Lambert, Asheville, North Carolina

Jerome V. Mankins, Forest Biology and Entomology Laboratory, Siguatepeque, Honduras, C.A.

Wayne N. Mathis, Department of Entomology, Smithsonian Institution, Washington, D.C.

Frank W. Mead, Florida Department of Agriculture, Gainesville, Florida

John C. Morse, Department of Entomology and Economic Zoology, Clemson University, Clemson, South Carolina

F. William Ravlin, Department of Entomology, Michigan State University, East Lansing, Michigan

Margaret Siri, Department of Entomology, University of California, Davis, California

Elbert L. Sleeper, Department of Entomology, California State University, Long Beach, California

Hans Ulrich, Museum A. Koenig, Bonn, West Germany

Karl Valley, Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, Pennsylvania

President Steyskal discussed arrangements for meetings, particularly the non-refreshment clause for facilities at the National Museum. It was moved and seconded that the Society petition the Smithsonian for permission to again have refreshments at the conclusion of meetings. President Steyskal also discussed the success of the recent Congress and problems relating to the distribution of the history of the Society to all Congress members. President Steyskal reported on a recent meeting of the Executive Committee in which it was suggested that other Society officers be handled on an officer-elect basis like the office of president. Further discussion will be delayed until the next meeting.

The amendment of the bylaws, as proposed May 6, 1976, was discussed and presented in written form to the Society. A vote will be taken at the next meeting.

Lloyd Knutson and President Steyskal reported that Memoir number 7 of the Society was published just before the Congress. The memoir is on ant larvae and was written by the Wheelers.

Ted Bissell brought oak leaves with white cocoons and larvae of the oak skeletonizer (*Bucculatrix ainshiella* Murtfeldt) to show. Bill Wirth reported

on the biology of a *Forcipomyia* species that was discovered on Plummers Island by Ted Spilman. President Steyskal reported that George Foster and he had reared the Celery Leaf Miner (*Euleia fratria* (Loew)) from *Cryptotaenia canadensis* and that some of the fly puparia were parasitized by an undescribed hymenopteran similar to one parasitizing a related European host.

The main speaker for the evening was Dr. Edward M. Barrows, Biology Department, Georgetown University. Dr. Barrows spoke on the behavior of sweat bees (Halictidae) and showed many kodachrome slides. The presentation was well delivered and stimulated many questions by the audience.

The meeting was adjourned at 9:45 P.M.
Wayne N. Mathis, *Recording Secretary pro tem*

836th Regular Meeting—November 4, 1976

The 836th Regular Meeting of the Entomological Society of Washington was called to order by President Steyskal at 8:00 P.M. on November 4, 1976, in the Ecology Theater of the National Museum of Natural History. Thirty-eight members and 14 guests were present. The minutes of the previous meeting were read and approved with corrections.

Membership Chairman Kingsolver read for the first time the names of the following new applicants for membership:

Harley P. Brown, Zoology Department, University of Oklahoma, Norman, Oklahoma 73019

John F. Carroll, Insect toxicologist-USDA ARS, 14813-301 Bowie Road, Laurel, Maryland 20811

Margaret S. Collins, Department of Zoology, Howard University, Washington, D.C.

Gary A. Coovert, Dayton Museum of Natural History, 2629 Ridge Ave., Dayton, Ohio 45414

Stephen W. Hildreth, Department of Entomology and Public Health, Yale University, New Haven, Conn. 06510

Thomas L. Mason, Jr., Division of Plant Sciences, Department of Entomology, West Virginia University, Morgantown, W. Va. 26506

Charles R. Parker, Department of Entomology, V.P.L., Blacksburg, Virginia 24061

Edwin M. Perkins, Jr., Department of Biological Sciences, University of Southern California, Los Angeles, California 90007

William Pyles, 1907 Quebec Street, Adelphi, Maryland 20783

Barbara Saffer, 3606 S.W. 31st Drive, Gainesville, Florida

Ingeborg Zenner-Polania, ICA, Tibaitata, Entomologia Ap. Aereo 151123, El Dorado, Bogota, Colombia

President Steyskal announced the following slate of candidates for Society Officers in 1977 proposed by the nominating committee:

President-elect	D. W. S. Sutherland
Treasurer	F. C. Thompson
Editor	M. B. Stoetzel
Membership Committee Chairman	J. A. Utmar
Corresponding Secretary	D. R. Whitehead
Program Committee Chairman	J. L. Hellman
Recording Secretary	W. N. Mathis
Custodian	D. R. Miller

Balloting will take place during the next meeting.

The Society voted unanimously to accept the proposed amendment to Article VII, Section 4 of the bylaws. The first sentence of Section 4 will now read, "The Publications Committee shall consist of the Editor as Chairman and *at least* three appointed members."

President Steyskal reported on his discussion with the Assistant Director of the Museum, Dr. Mello, concerning the Society's request to have refreshments after regular meetings. Because the meeting facility is relatively new, Dr. Mello again reiterated the Smithsonian's policy against refreshments. President Steyskal also discussed briefly the suggestion that all officers be handled on an officer-elect basis. For lack of interest, the subject was dropped. Treasurer Thompson stated that Society finances were in good order. Curt Sabrosky, President of the recent International Congress of Entomology, thanked the Society membership for their contribution to the success of the Congress.

Ted Bissell requested members for live specimens of the Giant Bark Aphid (*Longistigma caryae* (Harris)). Ashley Gurney introduced Arnold Mallis to the Society.

The main speaker for the evening was Dr. Paul Opler, Entomologist, Office of Endangered Species, U.S. Fish and Wildlife Service. He gave a presentation on, "Progress in Endangered Insect Conservation," which was accompanied by several kodachrome slides. A stimulating question and answer period followed Dr. Opler's talk.

The meeting was adjourned at 9:50 P.M.
Wayne N. Mathis, *Recording Secretary pro tem*

837th Regular Meeting—December 9, 1976

The 837th Regular Meeting of the Entomological Society of Washington was called to order by President Steyskal at 8:00 P.M. on December 9, 1976, in the Ecology Theater of the National Museum of Natural History. Twenty-four members and 5 guests were present. The minutes of the previous meeting were read and approved.

Acting Membership Chairman Utmar read for the first time the following new applicants for membership:

Eben A. Osgood, Entomology Department, University of Maine, Orono, Maine

R. Sobhian, Faculty of Sciences, Mashhad, Iran

Brian Francis Stone, 26110 Cornor Drive, Damascus, Maryland

J. Reese Voshell Jr., Department of Entomology, VPI and State University, Blacksburg, Virginia

Geoffrey B. White, 13113 Holly Ct., Beltsville, Maryland

President Steyskal pronounced the state of the Society to be "in good condition."

Treasurer Thompson presented his annual report, noting that the Society is in a good financial position with a 49% increase in total receipts and total worth of the Society is \$19,581.21, a 19% increase over last year. The Society has paid off \$3,400.00 of an internal loan. Increased sales of the Proceedings was also mentioned. The report is available for inspection by interested members. The Treasurer's report was voted on and passed unanimously. Treasurer Thompson and Past Treasurer Spilman were congratulated for their fine work.

Editor Knutson gave a report citing the help of George Steyskal with reviewing manuscripts for correct formation of scientific names and Many Stoezel on the editorial board. A highlight of the year was publication of Memoir number 7. The Editor's report was approved unanimously.

President Steyskal read the slate of officers for the coming year. A sheet of paper with the candidates' names was passed around the room. There were no nominations from the floor. It was moved and seconded that the slate be adopted and voting took place. The slate was adopted unanimously with several abstentions. New officers will be:

President-elect	D. W. S. Sutherland
Treasurer	F. C. Thompson
Editor	M. B. Stoezel
Membership Committee Chairman	J. A. Utmar
Corresponding Secretary	D. R. Whitehead
Program Committee Chairman	J. L. Hellman
Recording Secretary	W. N. Mathis
Custodian	D. R. Miller

Curtis Sabrosky reported that an inspected and certified "nematode free" anthurium plant he had acquired in Hawaii contained a small tipulid. He also visited Mrs. A. L. Melander, widow of the Dipterist, in Los Angeles. She is approximately 98 years old and in excellent health.

President Steyskal demonstrated the "CDT" or cereal dish trap developed

by the Department of Agriculture workers in Gainesville, Florida. The dish containing alcohol is sunk in the substrate with a bait suspended over it. It collected with amazing success. Besides dung beetles, many delicate and infrequently collected Diptera were taken, providing two new records.

The speaker for the evening was Dr. Robert Denno, Assistant Professor of Entomology, University of Maryland. Dr. Denno spoke on "The survival and diversity of insects inhabiting harsh salt marsh habitats." His talk was illustrated by many color slides. He reviewed the zonation of plant species in the marsh and the economic importance of salt marshes. He hypothesized that structural components as well as stress factors of the environment are important for the distribution of the homopterous species Dr. Denno studied. A stimulating question and answer period followed. Among the visitors introduced was Mr. Arly Allen, printer of the Proceedings.

The meeting concluded with the "official inaugural" of Maynard J. Ramsay. The gavel was handed over.

Mr. Ramsay gave a speech of introduction on his schooling and work in quarantine and regulatory entomology.

The meeting was adjourned at 10:00 P.M.
Joyce A. Utmar, *Recording Secretary pro tem*

838th Regular Meeting—January 6, 1977

The 838th regular Meeting of the Entomological Society of Washington was called to order by President Ramsay at 8:00 P.M. on January 6, 1977, in the Ecology theater of the National Museum of Natural History. Twenty-five members and 17 guests were present. The minutes of the previous meeting were read and approved with corrections.

Membership Chairman Utmar read for the first time the following new applicants for membership:

Anil Kumar Agarwal, C 2/3, River Bank Colony, Lucknow-226001,
(U.P.), India

Vicki H. Fedee, Associate Research Entomologist, Forestry Sciences
Laboratory, Carlton Street, Athens, Georgia 30602

Cecil L. Smith, Department of Entomology, University of Georgia,
Athens, Georgia 30602

Baldomero Villegas, Department of Entomology, University of Cali-
fornia, Davis, California 95616

President Ramsay reported that refreshments will again be served following adjournment of meetings and that Ms. Helen Sollers-Riedel would be chairman of the refreshments committee. Past President Steyskal was congratulated for pursuing this arrangement. Treasurer Thompson announced that notice of dues for the Society would be sent to the membership soon. President Ramsay reported that back issues of the Proceedings are in

demand and that where available, the Society would appreciate them. President Ramsay announced the consensus of a recent executive committee meeting that he continue as the Society representative to the Washington Academy of Sciences. President Ramsay also reviewed upcoming programs of the Academy, calling attention to their April meeting which will be on "Signaling by Fireflies." President Ramsay announced that the March meeting of the Society will include an insect artifact exhibit, i.e. stamps, textiles, etc. Program Chairman Hellman reported that a picnic-collecting outing was being planned for the Society. Arrangements were made to use the facilities of a 300 acre, former boys camp located near the Potomac River in Charles County, Maryland, near Nanjemoy. It was decided during the meeting to plan the outing for the weekend of May 13th, 14th, and 15th.

The principal speaker for the evening was Dr. W. Donald Duckworth, Department of Entomology, Smithsonian Institution. Dr. Duckworth spoke on tropical insect diversity, reviewing existing hypotheses and illustrating his talk with numerous Kodachrome slides of New World tropics. Dr. Duckworth's talk was followed by a stimulating question and answer period.

Several visitors were introduced and an announcement was made of the recent death of Mrs. Adam Böving.

The meeting was adjourned at 9:35 P.M. Punch, cookies, and fruitcake were served following the meeting.

Wayne N. Mathis, *Recording Secretary*

839th Regular Meeting—February 3, 1977

The 839th Regular Meeting of the Entomological Society of Washington was called to order by President Ramsay at 8:00 P.M. on February 3, 1977, in the Ecology Theater of the National Museum of Natural History. Thirty-seven members and 25 guests were present. The minutes of the previous meeting were read and approved.

Membership Chairman Utmar read for the first time the following new applicants for membership:

Earlene Armstrong, Department of Entomology, University of Maryland, College Park, Maryland 20742

George K. Bryce, Department of Biology, University of California, Los Angeles, California 90024

John J. Doria, 332 Eagle Harbor South, Laurel, Maryland 20810

Lee H. Townsend, Jr., Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061

Larry E. Watros, Department of Entomology, Ohio State University, 1735 Neil Avenue, Columbus, Ohio 43210

Hollis B. Williams, Department of Entomology, NHB 169, Smithsonian Institution, Washington, D.C. 20560

Lloyd Knutson reviewed the recent commemorative festivities in honor of Dr. Alan Stone, former unit leader of the U.S.D.A. Dipterists and long standing member of the Society. Dr. Stone was editor of the Proceedings from 1943 to 1947 and served as President in 1951. President Ramsay announced that Mr. Teddy G. Gates, Director of the Fairfax County Regional Science and Engineering Fair had requested the participation of the Society to help judge exhibits. President Ramsay called attention to upcoming programs of the Washington Academy of Sciences on February 17th, and of the Insecticide Society of Washington on February 16th. The subject of the Academy program is "Do Planets Explode?" President Ramsay reminded the Society that next meeting will feature an exhibit of insect artifacts and that during the weekend of May 13-15, the Society will sponsor a picnic-collecting outing.

The program for the evening was presented by two of the Society's members. First, Past President George C. Steyskal gave his Presidential Address entitled "What is Systematic Entomology," and second, Curtis W. Sabrosky gave a slide presentation of a recent trip to India and Pakistan.

Notes and Exhibitions:

John Kingsolver showed slides of a trip he made to India and Joyce Utmar showed postcards printed at about the turn of the century which depicted cupids using insect aerial nets to collect hearts.

Several guests were introduced.

The meeting was adjourned at 9:35 P.M. after which cookies and punch were served.

Wayne N. Mathis, *Recording Secretary*

PUBLICATIONS FOR SALE BY THE ENTOMOLOGICAL SOCIETY OF WASHINGTON

MISCELLANEOUS PUBLICATIONS

Cynipid Galls of the Eastern United States, by Lewis H. Weld	\$ 5.00
Cynipid Galls of the Southwest, by Lewis H. Weld	3.00
Both papers on cynipid galls	6.00
Identification of Alaskan Black Fly Larvae, by Kathryn M. Sommerman ..	.25
Unusual Scalp Dermatitis in Humans Caused by the Mite <i>Dermatophagoides</i> , by Jay R. Traver	.25
A Short History of the Entomological Society of Washington, by Ashley B. Curney	.50

MEMOIRS OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON

No. 1. The North American Bees of the Genus <i>Osmia</i> , by Grace Sandhouse. 1939	\$15.00
No. 2. A Classification of Larvae and Adults of the Genus <i>Phyllophaga</i> , by Adam G. Boving. 1942	15.00
No. 3. The Nearctic Leafhoppers, a Generic Classification and Check List, by Paul Wilson Oman. 1949	15.00
No. 4. A Manual of the Chiggers, by G. W. Wharton and H. S. Fuller. 1952	15.00
No. 5. A Classification of the Siphonaptera of South America, by Phyllis T. Johnson. 1957	15.00
No. 6. The Female Tabanidae of Japan, Korea and Manchuria, by Wallace P. Murdoch and Hiroshi Takahashi. 1969	15.00
No. 7. Ant Larvae: Review and Synthesis, by George C. Wheeler and Jeanette Wheeler. 1976	11.00

Back issues of the Proceedings of the Entomological Society of Washington are available at \$15.00 per volume to non-members and \$9 per volume to members of the Society.

Prices quoted are U. S. currency. Dealers are allowed a discount of 10 per cent on all items, including annual subscriptions, that are paid in advance. All orders should be placed with the Custodian, Entomological Society of Washington, c/o Department of Entomology, Smithsonian Institution, Washington, D.C. 20560

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PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY of WASHINGTON



DEPARTMENT OF ENTOMOLOGY
SMITHSONIAN INSTITUTION
WASHINGTON, D.C. 20560

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THE ENTOMOLOGICAL SOCIETY OF WASHINGTON

ORGANIZED MARCH 12, 1884

OFFICERS FOR 1977

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All correspondence concerning Society business should be mailed to the appropriate officer at the following address: Entomological Society of Washington, c/o Department of Entomology, Smithsonian Institution, Washington, D.C. 20560.

MEETINGS.—Regular meetings of the Society are held in the Ecology Theater, Natural History Building, Smithsonian Institution, on the first Thursday of each month from October to June, inclusive, at 8 P.M. Minutes of meetings are published regularly in the *Proceedings*.

MEMBERSHIP.—Members shall be persons who have demonstrated interest in the science of entomology. Annual dues for members are \$9.00 (U.S. currency) of which \$8.00 is for a subscription to the *Proceedings* of the Entomological Society of Washington for one year.

PROCEEDINGS.—Published quarterly beginning with January by the Society at Washington, D.C. Members in good standing receive the *Proceedings* of the Entomological Society of Washington. Nonmember subscriptions are \$15.00 per year, domestic, and \$17.00 per year, foreign (U.S. currency), payable in advance. All remittances should be made payable to *The Entomological Society of Washington*.

The Society does not exchange its publications for those of other societies.

Please see inside back cover of any 1972-1975 issue for instructions regarding preparation of manuscripts.

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A TAXONOMIC STUDY OF *HEMIGYMNASPIS* (LINDINGER)
(HOMOPTERA: DIASPIDIDAE) INCLUDING DESCRIPTIONS
OF FOUR NEW SPECIES¹

John A. Davidson and Douglass R. Miller

Abstract.—A generic diagnosis of *Hemigymnaspis* is given and four new species are described and illustrated; they are *Hemigymnaspis brayi* from Dominica, *H. jessopae* from southern Florida, *H. orchidicola* from Venezuela, and *H. pimentae* from the Dominican Republic. A key is given for the five species.

In 1972, Davidson redescribed *Hemigymnaspis* and gave a detailed treatment of the only included species *H. eugeniae* (Lindinger). Since that time, four additional species have been discovered and are here described.

Methods and Depositories

Terminologies used in the descriptions of the adult male and first instar are that of Ghauri (1962) and Stuetzel and Davidson (1974) respectively. Terminology regarding sclerotized areas on the pygidium of the adult female is that of Davidson (1970).

In the descriptions, total numbers of structures are given for half of the body as they appear on the illustrations unless indicated otherwise. For example, on *H. eugeniae* there is an average of 60 pygidial macroducts on each specimen; in the description we state that there are about 30. Numerical values are based on 10 specimens and are given as a range followed by an average (rounded off to the nearest whole number) in parentheses.

Depositories and their abbreviations are as follows: British Museum (Natural History), London (BM); California State Department of Agriculture, Sacramento (CDA); Florida State Collection of Arthropods, Gainesville (FSCA); Museo de Historia Natural de la Ciudad de Mexico, Mexico City (MNC); Museum National d'Histoire Naturelle, Paris (MNH); South African National Collection of Insects, Pretoria (SA); University of California, Davis (UCD); University of Delaware, Newark (UD); University of Hawaii at Manoa, Honolulu (UH); United States National Museum of Natural History, Washington, D.C. (USNM); Virginia Polytechnic Institute and State University, Blacksburg (VPI); Zoological Academy of Science of USSR, Leningrad (ZAS).

Genus *Hemigymnaspis* Lindinger, 1934

Hemigymnaspis Lindinger, 1934:45 (as a subgenus of *Melanaspis* Cockrell).

Type-species, *Melanaspis* (*Hemigymnaspis*) *eugeniae* Lindinger, 1934 by original designation and monotypy.

Adult Female

Diagnosis.—Pygidium usually retracted into prosoma at maturity; 4–6 lobes, lobes 1–2 longer than wide, lobes 3–6 normally wider than long; 2 setae located over lobe 1; normally 4 sclerotized areas on each side of body; submedial setae on each abdominal segment; perivulvar pores scattered around vulva, normally not forming distinct groups. Prosoma sclerotized anteriorly on mature females; gland spines or gland tubercles lateral; antenna with 2–4 conspicuous setae; paraspircular areas frequently lightly sclerotized, without pores.

Notes.—The adult female of *Hemigymnaspis* has features atypical of most members of the tribe Aspidiotini, i.e.,—dorsosubmedial setae on each abdominal segment, gland tubercles or gland spines, and more than one conspicuous seta on antenna.

Hemigymnaspis resembles *Furcaspis* Lindinger. Besides sharing the above atypical Aspidiotini features, these genera also share other unusual features, i.e.,—4 sclerotized areas on each side of the pygidium, 2 dorsal setae over the center of lobe 1, at least 4 pairs of lobes, and perivulvar pores scattered around vulva. *Furcaspis* has the interlobular plates furcate, the anterior paraspircular area with pores, the 3rd lobes are longer than wide, and the interlobular space between lobes 3 and 4 at least twice as long as the width of lobe 3. *Hemigymnaspis* differs by having the plates of various shapes, not furcate, the paraspircular areas without pores, the 3rd lobe normally longer than wide, and the interlobular space between lobes 3 and 4 about equal to the width of lobe 3.

Adult Male

Diagnosis.—Dorsosubmarginal setae on each abdominal segment; lateral area of abdominal segment 8 produced into lobe; pronotal ridges fused medially; ocelli absent; postocular and preoral ridges fused, without intervening sclerotized plate.

Notes.—The adult male of *Hemigymnaspis* has features atypical of all other members of the Aspidiotini except *Furcaspis*, i.e.,—the occurrence of a complete row of dorsosubmarginal setae on the abdomen and the lack of ocelli.

The diagnostic characters given for the male of *Hemigymnaspis* separate it from all other diaspids. Based on our examination of the males of *Furcaspis biformis* Cockerell and *F. charmoyi* Brain, *Furcaspis* lacks lobes on segment 8, has medially separate pronotal ridges, and has separate postocular and preoral ridges.

First Instar

Diagnosis.—Pygidium with 2 lobes, medial lobe with basal sclerosis, lateral lobe without sclerosis; dorsosubmarginal setae on each abdominal segment; paraspircular areas without pores; antenna 6-segmented; tibio-tarsal division distinct.

Notes.—The first instar of *Hemigymnaspis* and *Furcaspis* is an unusual member of the Aspidiotini because it has complete rows of dorsosubmedial setae, a 6-segmented antenna, and a distinct tibio-tarsal division. These character states were previously believed to be characteristic of tribes other than the Aspidiotini.

The diagnostic features given for the first instar of *Hemigymnaspis* separate it from all other diaspidids. The first instar of *Furcaspis biformis* has each of these characters except it has a paraspircular pore near each anterior spiracle. *Furcaspis biformis* differs further by having the 2nd lobe with the distal apex forming a large rounded lobule about as wide as the entire lobe, the plates between the medial lobes are simple, and the dorsomarginal setae on the abdomen are as long as the femur. *Hemigymnaspis* as represented by *H. brayi* Davidson and Miller, n. sp. has the 2nd lobe with the distal apex forming a small point that is less than $\frac{1}{3}$ as wide as the entire lobe, each plate between the medial lobes has 6–9 times, and the dorsomarginal setae on the abdomen are less than $\frac{1}{3}$ as long as the femur.

Key to Species of *Hemigymnaspis* (Adult Females)

1. Each side of pygidium with 5 or 6 lobes and more than 10 macroducts 2
 - Each side of pygidium with 4 lobes and less than 5 macroducts (Florida) *jessopae*, new species
2. Plates serrate, bifurcate, or trifurcate; plates between lobes 4 and 5 approximately as long as each lobe; small sclerotized spot anterior of 2nd sclerotized area 3
 - Plates simple; plates between lobes 4 and 5 less than half length of each lobe; without small sclerotized spot anterior of 2nd sclerotized area (Dominica) *brayi*, new species
3. Less than 40 macroducts on each half of pygidium; marginal areas of head with few microducts 4
 - More than 50 macroducts on each half of pygidium; marginal areas of head with dense row of microducts (Dominican Republic) *pimentae*, new species
4. Space between lobes 2 and 3 with 3 plates; area posterolaterad of spiracle clear, without dermal striations; paraphyses short (Fig. 5) (Venezuela) *orchidicola*, new species

- Space between lobes 2 and 3 with 2 plates; area posterolaterad of spiracle with dermal striations; paraphyses long (Puerto Rico, Virgin Islands) *eugeniae* (Lindinger)

Hemigymnaspis brayi Davidson and Miller, new species

Type-data.—Holotype adult female on slide with 4 other specimens; holotype nearest bottom of slide with left label "*Hemigymnaspis brayi* Davidson and Miller, On Araceae probably *Anthurium* (?) bark, on trail to Boire Lake from Fresh Water Lake, Dominica, D. F. Bray, Feb. 22, 1964," right label with map of position of holotype on slide and "*Hemigymnaspis brayi* Davidson and Miller HOLOTYPE and PARATYPES" (USNM). There are 101 paratypes with same data on 22 slides; at least 1 slide is deposited in each of the following: BM, CDA, FSCA, MNC, MNH, SA, UCD, UD, UH, USNM, VPI, ZAS.

Field characters.—The female cover is elongate oval, slightly convex, black, with the beige exuviae terminal. The male cover is similar in shape and texture but smaller, flat, light brown, with the yellow-brown exuviae subterminal. The scales were located in bark crevices.

Adult Female

(Fig. 1)

Recognition characters.—Holotype adult female 0.8 mm long (paratypes 0.6–0.8 (0.8)), 0.6 mm wide (paratypes 0.5–0.7 (0.6)); prosomal sclerotization limited to body margin of head and anterior thorax.

Prosomal dorsum with small microducts scattered over submedial areas of thorax and abdomen; larger microducts in irregular band along body margin from anterior part of pygidium to posterior margin of thorax; gland spines absent; 3 cicatrices and sclerotized eye. Prosomal venter with antenna bearing 4 conspicuous setae; paraspiracular areas sclerotized, forming plate about 3 times as long as diameter of spiracle; cicatrices absent; microducts of 3 types, marginal ducts largest, with sclerotized dermal orifice, about size as those on margin of dorsum, on anterior abdominal segments and posterior thoracic segments, smaller ducts without sclerotized orifices, present along body margin and in submedial area, absent from head, ducts similar to those in submarginal tubercles; tubercles scattered along body margin, intergrading in form with gland spines.

Pygidium rounded apically. Pygidial dorsum with 4 distinct sclerotized areas, area 2 partially or completely divided near submargin. Macroducts primarily on sclerotized areas, ducts of 1 size, 40 ducts on 1 side of body and 41 on other (paratypes 38–56 (47)); sclerotized spot near apex of 2nd sclerotized area absent; anal opening slightly posterior of pygidial

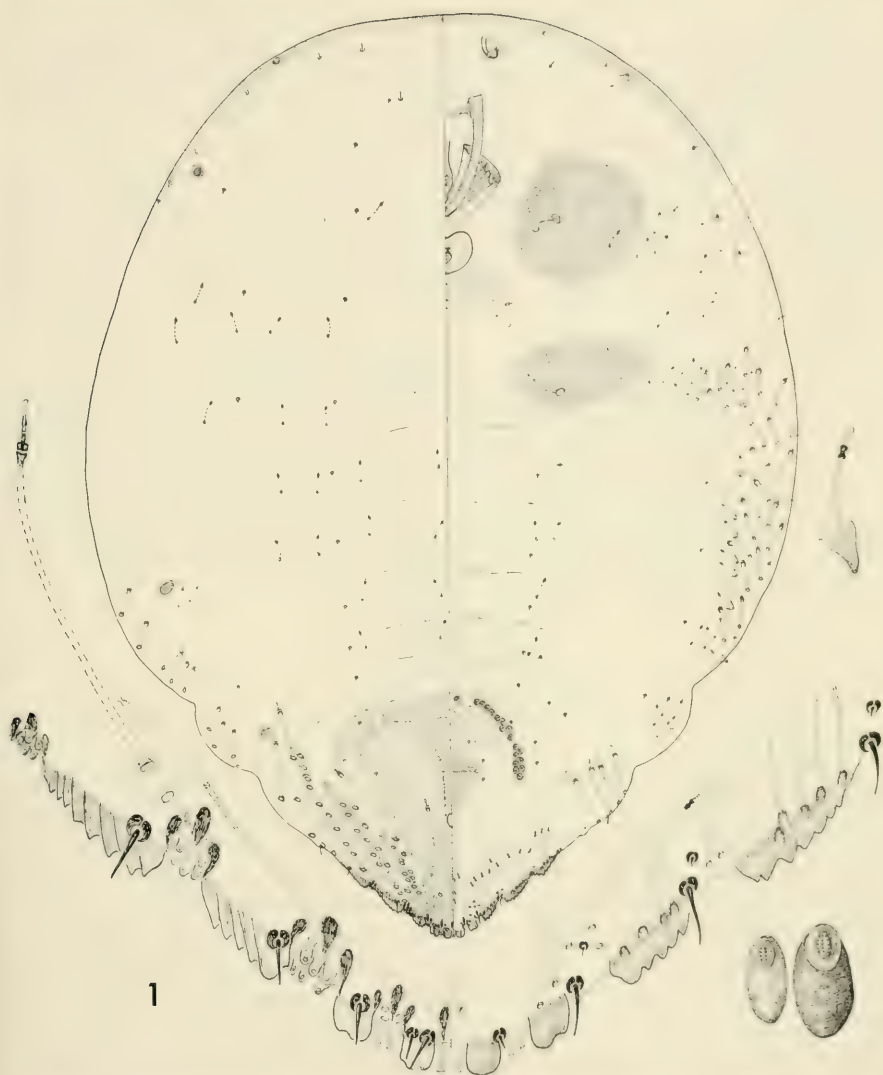


Fig. 1. *Hemigymnaspis brayi*, adult female holotype, dorsal and ventral aspects.

midlength. Pygidium with 5 lobes, medial lobe with trace of lateral notch, lobe 2 with deep lateral notch, lobes 3-5 wider than long, serrate, with dorsal setae on medial side of lobes 3 and 4 and on lateral side of lobe 5, dorsal seta of segment 3 absent. Plates between medial lobes apically expanded, remaining plates indefinite, represented by several small lobules.

each plate with unusually long microduct. Pygidial venter with many microducts near body margin; perivulvar pores scattered around vulva, not organized into groups. Vulva anterior of pygidial midlength. Paraphyses short, 2 between medial lobes, 3 between medial lobe and lobe 2, and 3 between lobes 2 and 3.

Variation.—The paratypes sometimes have the cicatrix nearest the head absent and occasionally they have a cicatrix near the antenna; the paratypes sometimes have a dorsal seta on segment 3 and a completely sclerotized area 2. All adult-female material is newly matured. We believe that older specimens are more heavily sclerotized and the pygidium is partially retracted into the prosoma.

Notes.—The above description is based on 85 specimens.

Hemigymnaspis brayi differs from all other species of the genus by having 3 paraphyses between each of lobes 2 and 3, 3 and 4, and 4 and 5; by having plates small and lobelike, paraspircular areas sclerotized into plates that are about 3 times as long as spiracle diameter, microducts of plates with unusually long inner filaments, and by lacking a small sclerotized spot anterior of sclerotized area 2. These features are unique to *H. brayi* within *Hemigymnaspis*.

Adult Male

(Fig. 2)

Recognition characters.—Allotype, mounted, 0.8 mm long, 0.2 mm wide at mesothorax.

Dorsum with lateral margin of segment 8 produced into lobe with 3 marginal setae. Setae as illustrated, complete longitudinal line of setae on mediolateral areas of abdomen, 3 pairs of setae on prescutum and scutum. Abdominal sclerotization conspicuous, with medial tergitelike structure visible on each segment. Metathorax with elongate postnotum; suspensorial sclerites represented by small sclerotized spot near halteres. Mesothorax with prescutum subtransverse and weakly reticulate; scutum without reticulation; scutellum with indefinite foramen; postnotal triangular area with longitudinal striation. Prothorax with pronotal ridges fused medially; lateral pronotal sclerites and posttergites conspicuous; median pronotal sclerite apparently absent. Head with definite midcranial ridge, lateral arms small; dorsal part of preocular and postocular ridges forming heavily sclerotized plate around dorsal eye; postoccipital ridge lightly sclerotized medially, anterior arms forming triangular plates, posterior arms heavily sclerotized, lightly sclerotized areas behind posterior arms forming noticeable plates. Dorsal eye about $24\ \mu$ in diameter. Ocelli absent.

Penial sheath about $262\ \mu$ long; greatest width/length about 0.2; anal opening somewhat larger than normal for diaspidid.

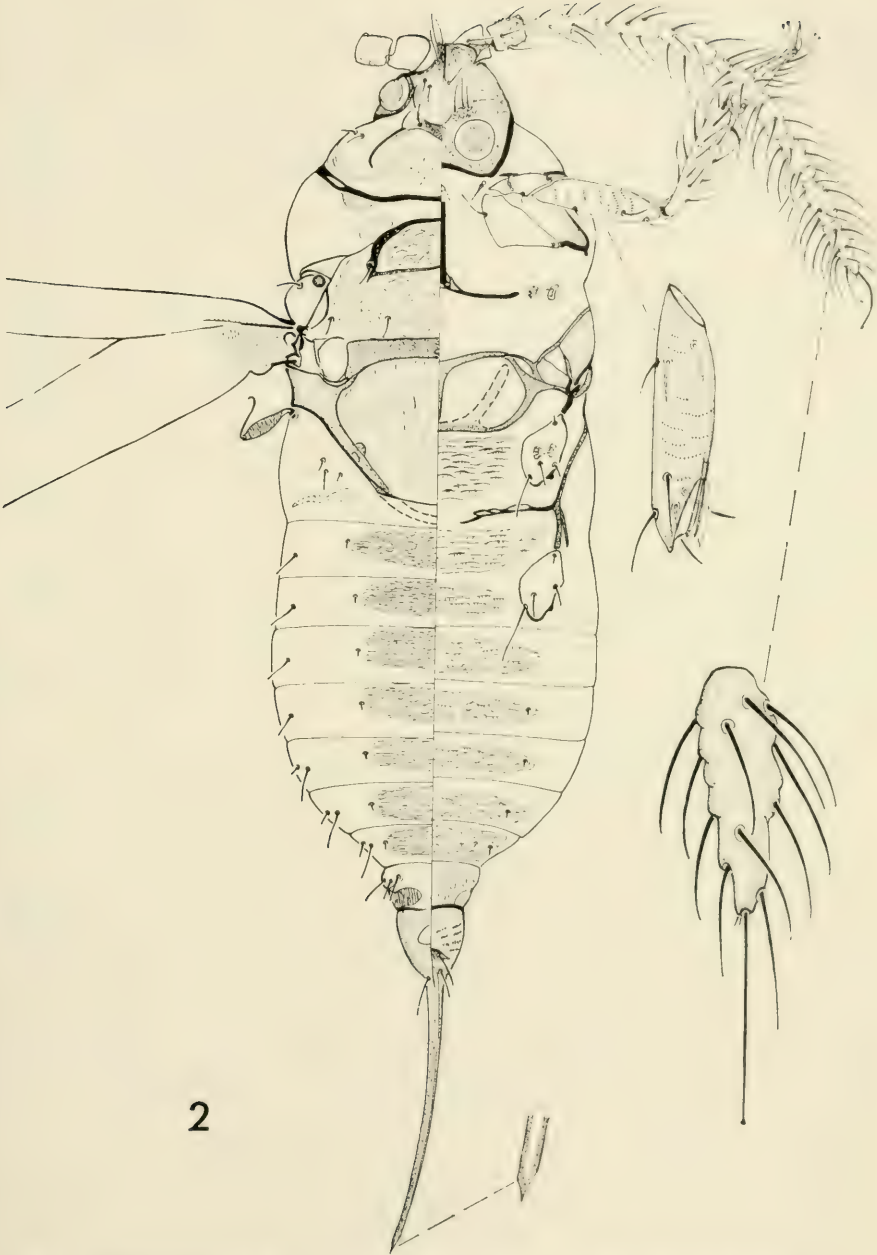


Fig. 2. *Hemigymnaspis brayi*, adult male allotype, dorsal and ventral aspects.

Venter with setae as illustrated, ventral abdominal setae difficult to discern because of condition of specimens. Abdominal sclerotization conspicuous medially. Metathorax without episternum, with noticeable precoxal ridge and basisternum; area anterior of precoxal ridge sclerotized. Mesothorax with basisternum divided by median ridge. Prothorax with sternum well developed, median and lateral arms conspicuous, without triangular plates. Head with midcranial ridge thin; preocular ridge indefinite; postocular ridge well developed, fused with preoral ridge; ventral plates indefinite.

Legs represented by prothoracic pair only, others broken; setae predominantly hairlike, tibia with spur distally, tarsus with several bifurcate setae, claw digitules broken; trochanter apparently with 6 sensilla, tarsus with 1; tibia tarsus 1.3. Antennae about half as long as body length, 10-segmented, third segment about 1.2 times longer than apical segment; antennal setae primarily simple, hairlike on first 3 segments, "sensory pegs" on segments 3 and 10, and porelike sensillum on segment 2.

Notes.—The above description is based on 3 specimens, 2 in exuviae of pupae.

The adult male of this species is unusual by having dorsosubmarginal setae on each abdominal segment, marginal setae on abdominal segment 8 on a lobe, the medial areas of abdominal segments distinctly sclerotized, the pronotal ridges fused medially, a sclerotized plate behind each posterior arm of the postoccipital ridge, the ocelli absent, the postocular ridges fused with the preoral ridges.

The sclerotization of the medial areas of the abdomen associates *Hemigymnaspis brayi* with *Aspidiotus nerii* Bouché, *A. destructor* Signoret, and *A. excisus* (Green); the fused preoral and postocular ridges suggest a relationship to *Parlatoria oleae* (Colvec), *P. morrisoni* McKenzie, and *P. blanchardii* (Targioni-Tozzetti). The occurrence of a medially fused pronotal ridge and a sclerotized plate behind the lateral arms of the postoccipital ridges are features of *H. brayi* unknown in other diaspidid males. The occurrence of a complete series of dorsosubmarginal setae on the abdomen and the lack of lateral ocelli are features characteristic of the Diaspidini not Aspidiotini. With *H. brayi* a member of the latter tribe, this is the first report of these character states in the Aspidiotini. These unusual Aspidiotini states also occur in *Furcaspis biformis* and *F. charmoiyi* and are reported here for the first time.

First Instar
(Fig. 3)

Recognition characters.—Mounted, 0.3–0.4 (0.3) mm long, 0.2–0.3 (0.2) mm wide.

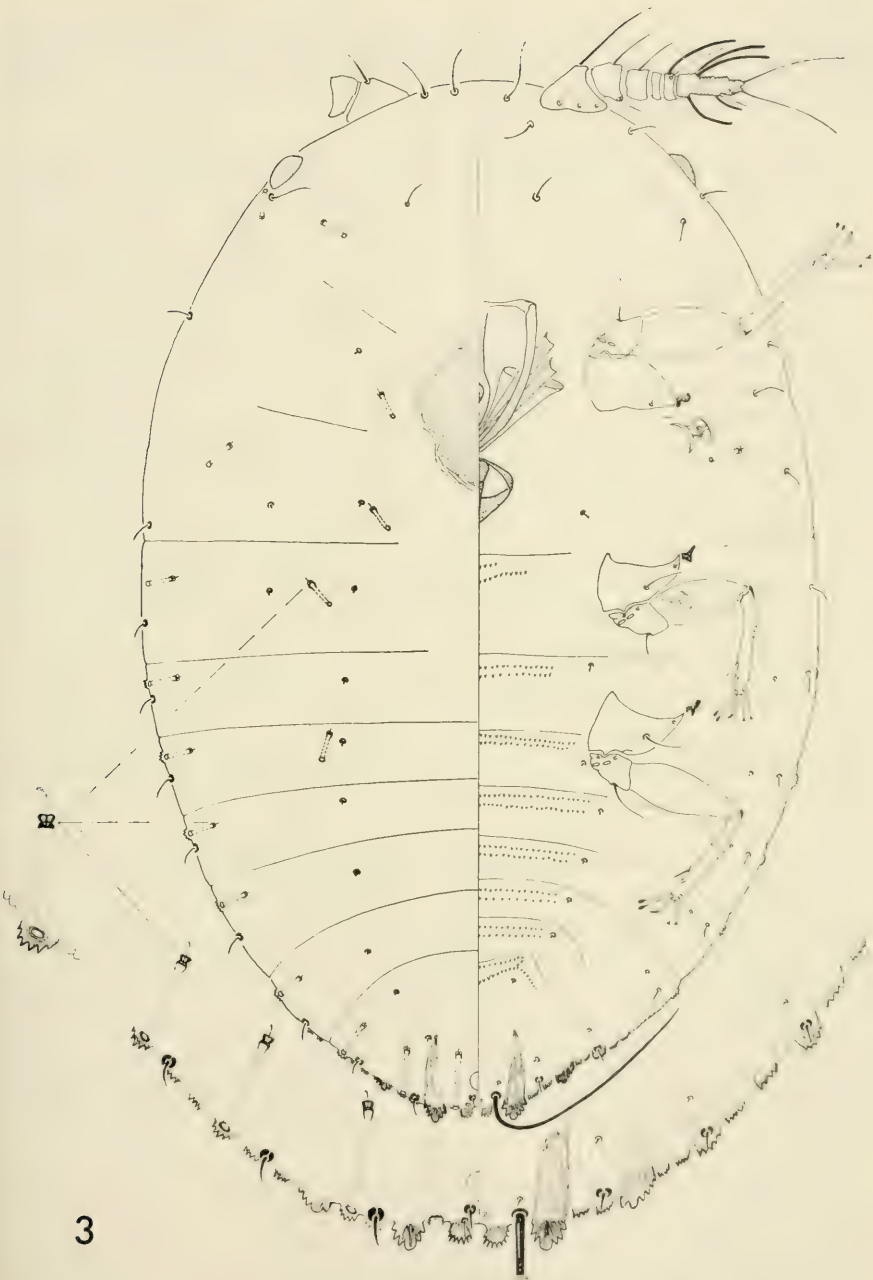


Fig. 3. *Hemigymnaspis brayi*, first instar, dorsal and ventral aspects.

Dorsum with setae and tubular ducts as illustrated; longitudinal line of submedial setae on abdomen typical of Diaspidini, paired setae on meso- and metathorax and distribution of ducts typical of Aspidiotini. Anal ring about diameter of ring away from apex of body. Sclerotized area directly over mouthparts.

Marginal areas with 2 lobes homologous to lobes 2 and 3 on adult female, lobe 2 with basal sclerosis and 2 medial and 3 lateral notches, lobe 3 without sclerosis, with 1 medial and 2-5 lateral notches. Plates between 2nd lobes with 6-9 tines, between lobes 2 and 3 with 3-6 tines; plates anterior to lobe 3 variable in number, normally 3/segment, but on fully expanded crawlers all but plates associated with ducts absent.

Venter with setae and ducts typical of Aspidiotini. Legs with coxae each with setae, 1 on ventral surface and 2 on dorsal surface, trochanter with 2 sensilla on each surface and with 1 large and 2 small setae, femora and tibiae without setae, tarsi each with 1 seta, 2 capitate digitules, and 2 sensilla, tarsal sensillum near juncture of tibia on legs of all specimens, tibia and tarsus separate, tibia/tarsus 0.5-0.7 (0.6); claws each with 2 capitate digitules. Antenna 6-segmented, 52-58 (56) μ long, segments 2-5 each about same length, apical segment about 0.6 times as long as total length of remaining segments. Anterior spiracle without paraspiracular pore.

Notes.—The above description is based on 7 specimens.

The first instar of *H. brayi* is an unusual member of the Aspidiotini because it has a complete row of submedial setae, 6-segmented antenna, and a distinct division between the tibia and tarsus; these are features previously believed to be characteristic of other tribes.

The first instar of *Furcaspis biformis* also has the above characters. *Hemigymnaspis brayi* and *F. biformis* differ by the 2nd lobes of the latter with the distal apex forming a large rounded dome about as wide as lobe, the plates between the lobes simple, the anterior spiracles each with a single paraspiracular pore, dorsomarginal setae on the abdomen as long as the femur, and antennal segments 2-5 each about the same length. *Hemigymnaspis brayi* has the 2nd lobes with the distal apex forming a small point which is less than $\frac{1}{3}$ as wide as the lobe, the plates between the 2nd lobes with 6-9 tines, the anterior spiracle without associated pores, and the dorsomarginal setae on the abdomen less than $\frac{1}{3}$ as long as the femur.

We take great pleasure in naming this species in honor of Dale F. Bray, Department of Entomology and Applied Ecology, University of Delaware, who collected this and many other interesting scale species in Dominica. Dr. Bray collected the material while participating in the Bredin-Archbold-Smithsonian Biological Survey of Dominica.

The host of this species is uncertain. Dr. Bray feels certain that the host

is a member of the Araceae and is fairly well convinced that it is a species of *Anthurium*, but he is not positive.

Hemigymnaspis eugeniae (Lindinger)

This species was redescribed and illustrated in detail by Davidson (1972), therefore we are including here additions only.

Adult Female

Recognition characters.—Prosomal dorsum with 2 or 3 submarginal cicatrices, 1 near eye, rarely 1 on thorax, and 1 near juncture of thorax and abdomen. Prosomal venter with paraspiracular areas sometimes weakly sclerotized into oval plates, these areas slightly longer than length of spiracle diameter. Pygidial dorsum with macroducts primarily restricted to sclerotized areas, ducts of 2 sizes, large size near lobes 1 and 2, with 25–33 (29); small sclerotized spot near apex of each 2nd sclerotized area. Two large dorsal setae on lobe 1. Rarely pygidium with 6th lobe and 2 plates between lobes 5 and 6.

Notes.—*Hemigymnaspis eugeniae* is most similar to *H. orchidicola* Davidson and Miller, n. sp., but differs by having 2 plates between lobes 2 and 3 and fewer gland spines along posterior portion of body margin of prosoma, and by lacking clear areas posterolaterad of each spiracle. *Hemigymnaspis orchidicola* has 3 plates between lobes 2 and 3, more gland spines along posterior portion of body margin of prosoma, and large clear areas posterolaterad of each spiracle. For a comparison of *H. eugeniae* with *H. pimentae* see "Notes" of the latter species.

Hemigymnaspis jessopae Davidson and Miller, new species

Type-data.—Holotype adult female on slide with left label "*Hemigymnaspis jessopae* Davidson and Miller, on *Eugenia simpsonii* A. Sarg., nr. Orchid, Indian River Co., Fla. V-8-'75, D. R. Miller, R. F. Denno, J. A. Davidson #2980," right label "*Hemigymnaspis jessopae* Davidson and Miller, HOLOTYPE" (USNM). There are 10 paratypes with same data on 3 slides; 1 slide is deposited in the BM, the others are in the USNM.

Field characters.—This species occurs on the bark of the host just above and below the soil surface.

Adult Female

(Fig. 4)

Recognition characters.—Holotype adult female 0.8 mm long (paratypes 0.6–0.7 (0.7)), 0.6 mm wide (paratypes 0.5–0.7 (0.6)); prosomal sclerotization limited to body margin of head, thorax, and anterior abdomen.

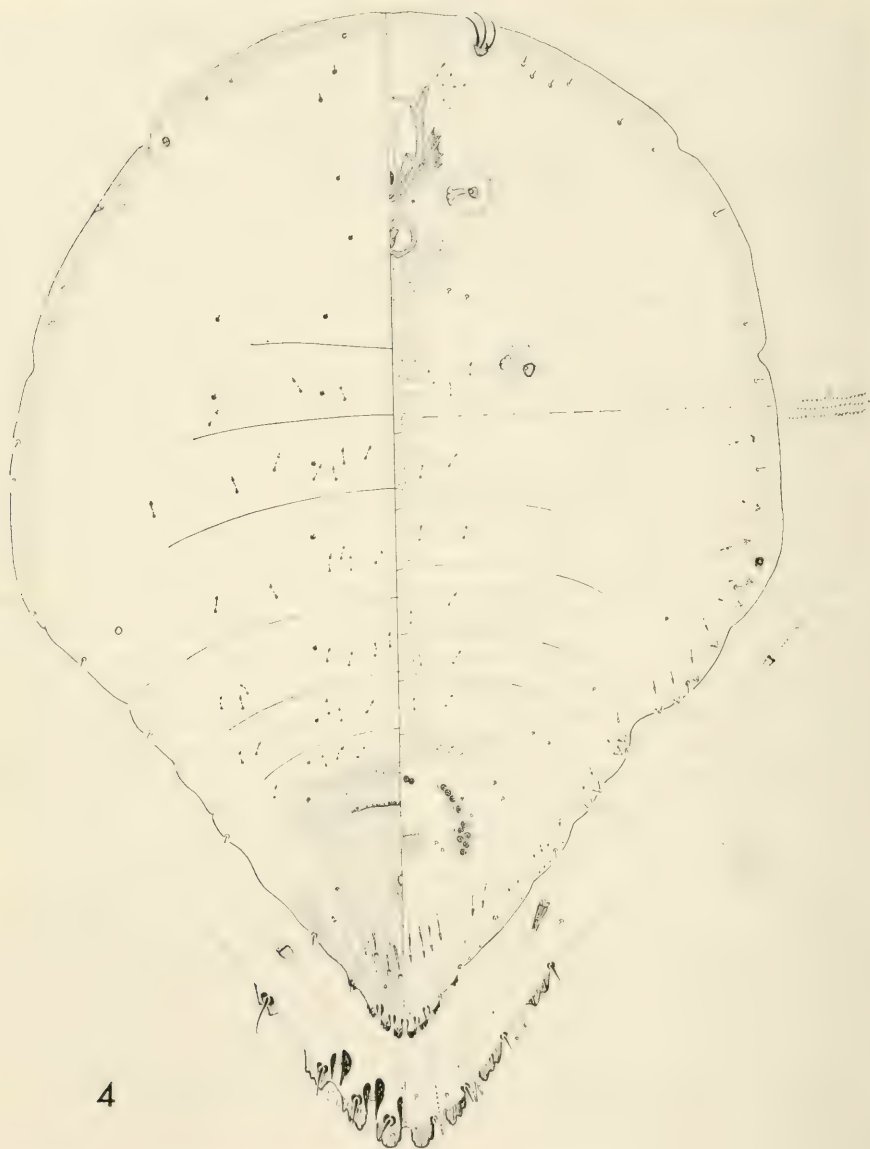


Fig. 4. *Hemigynaspis jessopae*, adult female holotype, dorsal and ventral aspects.

Prosomal dorsum with small microducts in submedial areas of anterior abdominal segments and posterior thorax; larger microducts absent from margin; gland spines absent; cicatrices variable, indefinite, eye apparently absent. Prosomal venter with antenna bearing 3 conspicuous setae; an-

terior paraspiracular areas clear, posterior paraspiracular areas sclerotized, forming plate about equal to length of spiracular diameter; cicatrix on abdominal segment 1; microducts of 2 types, ducts near body margin of abdomen and posterior thorax forming small gland spines or tubercules at dermal orifice, smaller ducts scattered over venter.

Pygidium acute apically. Pygidial dorsum with 4 distinct sclerotized areas, area 2 undivided. Macroducts restricted to sclerotized areas, ducts of 1 size, 2.5 on 1 side of body and 3.5 on other, present between medial lobes, lobes 1 and 2, and 2 and 3, 1 side of body with macroduct near lateral margin of medial sclerotized area just anterior of paraphyses between lobes 2 and 3 (paratypes 2.5–3.5 (2.5) macroducts); small sclerotized spot near apex of 2nd sclerotized area; anal opening slightly anterior of pygidial midlength. Pygidium with 4 lobes, becoming increasingly broad anteriorly; medial lobe with 1 lateral and 1 medial notch, lobe 2 with 2 lateral notches, lobe 3 with 2 lateral notches, lobe 4 with 1 or 2 lateral notches; lobe setae over center of each lobe. Plates between medial lobes absent or broken, space between medial lobe and lobe 2 with 1 plate, spaces between lobes 2 and 3 and 3 and 4 with 2 plates; plates each with 1 slender microduct, these ducts with unusually long inner filament. Pygidial venter with few microducts scattered along body margin anterior of lobe 4, microducts without long inner filaments; perivulvar pores organized into 5 indefinite groups. Vulva anterior of pygidial midlength. Paraphyses moderately long, 2 between medial lobes, and 2 between each of lobes 1 and 2, and lobes 2 and 3.

Variation.—The paratypes frequently have more prepygidial microducts, rarely have an eye, rarely have anterior paraspiracular area sclerotized, may have 2nd sclerotized area with apical portion separate from marginal portion, and may have areas 3 and 4 fused. The plates and lobes are quite variable; lobe 1 may have 1 or 2 lateral notches and 0–1 medial notches, lobe 2 may have 1–3 notches, lobe 3 may have 2–3 notches, and lobe 4 may have 1–4 notches; normally 2 small plates are between medial lobes, 1–2 between medial lobes and 2, 0–2 between lobes 2 and 3, 1–3 between lobes 3 and 4, and 1 plate anterior of lobe 4.

Notes.—The above description is based on 11 specimens.

Hemigymnaspis jessopae differs from all other species of the genus by having less than 5 macroducts on each side of pygidium, 4 lobes, and an apically acute pygidium. These features are unique to *H. jessopae* within *Hemigymnaspis*.

We take great pleasure in naming this species in honor of Dorothy S. Jessop who has made thousands of microscope slides of scale insects. We are grateful for her dedication to the preparation of high quality scale-insect slides which will continue to serve as the basis for much of the Coccoidea taxonomic research in the U.S.

Hemigymnaspis orchidicola Davidson and Miller, new species

Type-data.—Holotype adult female on slide with left label "*Hemigymnaspis orchidicola* Davidson and Miller, Venezuela, ex orchid leaf, VIII-24-72, Miami no. 4287, J. C. Buff, Balsam," right label "*Hemigymnaspis orchidicola* Davidson and Miller, HOLOTYPE." There are 6 paratypes with the above data on 4 slides; 1 slide is deposited in the BM, the others are in the USNM.

Field characters.—The female cover is elongate oval, flattened, light beige, with the brown exuviae located off center. Most scales were found on the upper surface of the leaf.

Adult Female

(Fig. 5)

Recognition characters.—Holotype adult female 0.6 mm long (paratypes 0.7) 0.5 mm wide (paratype 0.6–0.7 (0.6)); prosomal sclerotization includes about $\frac{1}{3}$ of anterior dorsum.

Prosomal dorsum with small microducts in submedial areas of unsclerotized areas of abdomen, in marginal areas on mesothorax, and near eye; larger microducts in irregular band along body margin from anterior part of pygidium to posterior margin of thorax; large gland spines on margin from pygidium to posterior thorax; small gland spines or gland tubercles on margin of thorax and head, becoming ventral anteriorly; 3 cicatrices and large, protruding eye. Prosomal venter with antenna bearing 4 conspicuous setae; paraspicular areas weakly sclerotized, forming oval plates slightly longer than length of spiracular diameter; conspicuous clear area posterolaterad of each spiracle; cicatrices absent; microducts of 2 types, ducts on margin forming small gland spines mentioned on prosomal dorsum, ducts on submargin of abdomen and submedian of abdomen and thorax without dermal protrusions.

Pygidium rounded apically. Pygidial dorsum with 5 indefinite sclerotized areas. Macroducts primarily on sclerotized areas, ducts of 2 sizes; posterior ducts largest; pygidium with 26 ducts on 1 side of body and 25 on other (paratypes 23–31 (27)); sclerotized spot near apex of 2nd sclerotized area; anal opening slightly posterior of pygidial midlength. Pygidium with 5 lobes; medial lobe and lobe 2 each with 1 lateral and 1 medial notch, lobes 3–5 wider than long, serrate, with dorsal seta on medial side of each lobe. Plates between medial lobes similar to other plates, 2 between medial lobes, 2 between medial lobes and lobe 2, 3 between lobe 2 and 3, 3 between lobes 3 and 4, and 3 between lobes 4 and 5; plates each with 1 or 2 slender microducts, each duct with normal inner filament; interlobular spaces without small lobules. Pygidial venter with few small microducts; perivulvar pores organized into 2



Fig. 5. *Hemigymnaspis orchidicola*, adult female holotype, dorsal and ventral aspects.

pairs of groups or scattered. Vulva anterior of pygidial midlength. Paraphyses unusually short, usually 2 between each of medial lobes, medial lobes and lobe 2, and lobes 2 and 3.

Variation.—One paratype has the pygidium partially retracted into prosoma; the microtubular ducts are normally less abundant on the dorsum than on the holotype.

Notes.—The above descriptions are based on 7 specimens.

For a comparison of *H. orchidicola* with *H. eugeniae* and *H. pimentae* see "Notes" of the latter 2 species.

Hemigymnaspis pimentae Davidson and Miller, new species

Type-data.—Holotype adult female on slide with 2 other specimens; holotype nearest bottom of slide with left label "*Hemigymnaspis pimentae* Davidson and Miller, Dominican Republic, ex *Pimenta* sp. leaf, XI-19-75, JFKIA 21574, D. Walters, Balsam," right label with map of position of holotype and "*Hemigymnaspis pimentae* Davidson and Miller, HOLOTYPE and PARATYPES" (USNM). There are 10 paratypes with the same data on 4 slides; 3 slides are in the USNM; 1 is in the BM.

Field characters.—The female cover is oval, flattened, black with the black exuviae located subcentrally. Most scales were found on the under surface of the leaf.

Adult Female

(Fig. 6)

Recognition characters.—Holotype adult female 0.7 mm long (paratypes 0.5–0.6 (0.6)), 0.5 mm wide (paratypes 0.5–0.6 (0.6)); prosomal sclerotization absent.

Prosomal dorsum with small microducts scattered over submedial areas and near body margin of thorax and head; larger microducts abundant along body margin from pygidium to posterior thorax, same size as small macroducts on pygidium, becoming increasingly smaller anteriorly; 2 or 3 marginal gland spines on posterior abdominal segments; 2 cicatrices and slightly protruding sclerotized eye. Prosomal venter with antenna bearing 2 conspicuous setae; paraspircular areas weakly sclerotized, forming plate slightly longer than length of spiracular diameter; cicatrices absent; microducts of 2 types, ducts scattered over submedial and submarginal areas without dermal modifications, marginal ducts forming gland tubercles.

Pygidium apically rounded. Pygidial dorsum with 4 indefinite sclerotized areas. Macroducts not restricted to sclerotized areas, ducts of 2 sizes, large size near lobes 1 and 2, small size elsewhere, 61 ducts on 1 side of body and 52 on other (paratypes 55–73 (63)); sclerotized spot near apex of 2nd sclerotized area; anal opening well into anterior half of pygidial midlength. Pygidium with 6 lobes; medial lobe and lobe 2 each with 1 lateral and 1 medial notch, lobes 3–5 wider than long, serrate, with dorsal seta at medial side of lobe, lobe 6 represented by 1 or 2 small serrate projections. Plates between medial lobes similar to other plates, 2 between medial lobes, 2 between medial and 2nd lobes, 2 between 2nd and 3rd lobes, 3 between 3rd and 4th lobes, 3 between 4th and 5th lobes, and 2 between 5th and 6th

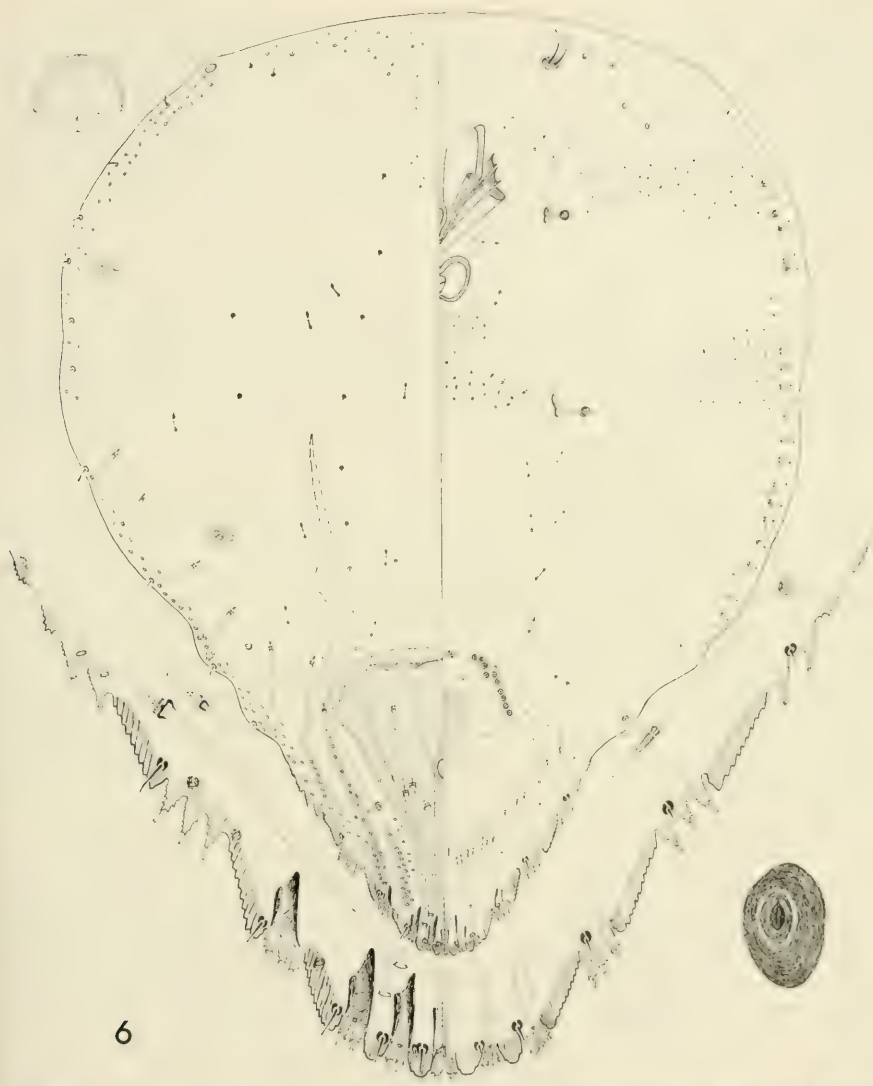


Fig. 6. *Hemigymnaspis pimentae*, adult female holotype, dorsal and ventral aspects.

lobes; plates each with 1 slender microduct, inner filament of normal length; interlobular space without small lobules. Pygidial venter with few small microducts on submargin; perivulvar pores scattered around vulva, not organized into groups. Vulva anterior of pygidial midlength. Paraphyses long, 2 between each of medial lobes, medial lobe and lobe 2, lobes 2 and 3.

Variation.—Most paratypes have the head and anterior thorax heavily sclerotized, and the pygidium partially retracted into prosoma; when the anterior part of the body is sclerotized, the gland tubercles are dorsal. Mature adult females have the sclerotized areas partially or completely fused; paratypes have 2–4 (3) conspicuous setae on each antenna; one specimen lacks the 6th lobe; several specimens have 3 plates between lobes 5 and 6.

Notes.—The above description is based on 7 specimens.

Hemigymnaspis pimentae is similar to *H. eugeniae* and *H. orchidicola*. It differs by having more pygidial macroducts, a dense band of microducts around the anterior margin of the head, and a cluster of microducts anterior of the front spiracle. *Hemigymnaspis eugeniae* and *H. orchidicola* have fewer pygidial macroducts and lack ducts in the areas mentioned above for *H. pimentae*.

Discussion

Hemigymnaspis brayi and *H. jessopae* have features of the interlobular plates which are atypical of other *Hemigymnaspis* species. We have considered placing *H. brayi* and *H. jessopae* in a new genus, but because they have many features typical of *Hemigymnaspis* species, we have decided to place them tentatively in *Hemigymnaspis*. We feel that many additional species will be found when more intensive collecting is done on native vegetation of the Caribbean Islands. When this new material is described, it may be easier to understand the range of characters in *Hemigymnaspis*.

Acknowledgments

We are grateful to Manya B. Stoetzel, Systematic Entomology Laboratory, IBIII, Agr. Res. Serv., Beltsville, Md. for her advice on the placement of the first instar and adult male of *H. brayi*. We also thank Kellie O'Neill, Donald M. Anderson, and Ronald W. Hodges, Systematic Entomology Laboratory, for reviewing and criticizing this manuscript.

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Footnote

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Notice

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Recent years have seen a marked increase in the number of journals devoted to short articles and a decrease in those devoted to longer, monographic papers. These adverse trends are the result of inflation in both scientific output and printing costs. The Entomological Society of Washington publishes a *Memoir* series which is devoted to longer, monographic papers. This series is irregular and volumes are published when suitable manuscripts (and money) are available. A Special Publication Fund has been established by the Society to help subsidize the cost of the *Memoirs* as well as other special publications. The Society would like to enlarge this fund so as to be able to produce more *Memoirs* and because the fund provides the only financial foundation and security the Society has. Members and other friends are urged to make donations to the Special Publication Fund.

F. Christian Thompson
Treasurer

RETRIEVAL OF FIRST INSTAR TACHINID LARVAE FROM PINNED SPECIMENS

F. William Ravlin

Abstract.—A method by which first instar tachinid larvae can be retrieved from dried pinned material for either slide preparations or scanning electron microscope examination is presented.

Except in such works as Townsend's *Manual of Myiology* (1934-1942), Hennig's *Die Larvenformen der Dipteren* (1952) and Thompson's *Tachinids of Trinidad* (1968, and earlier works), little progress has been made in the utilization of first instar characters of larviporous dipteran species. Examination of first instars offers the taxonomist a new range of morphological characters to be used in species determination. In addition, by making deductions concerning function through morphology, the biologist may gain insight into the host finding methods of the parasitoid involved. Thompson (1968) recognized the utility of first instars and showed significant differences in the cephalo-pharyngeal skeletons, sensoria, and cuticular armature.

The methods herein described are similar to those utilized by Thompson and others but never published (Sabrosky, personal communication) and to date not used in scanning electron microscope preparation.

First instars should normally be obtained from freshly caught adult females; however, this is not possible in most instances. Therefore, the procedure outlined below can be applied to dried, pinned material either singly or to a series of specimens. These procedures have been used not only with sclerotized groups, such as *Euphasiopteryx* Townsend, but also semi-membranous and membranous tachinid genera such as *Archytas* Jaenicke, *Microphthalma* Macquart, and *Hyalomyodes* Townsend (Ravlin, 1975).

1. Carefully remove the female abdomen at the base of the thorax.
2. Place the detached abdomen in 10% KOH for 8-10 h. After this time period the genitalia can be dissected from the abdomen. (Note: Distortion of bristles and sclerites can occur if boiled. In addition, NaOH may be substituted for KOH.)
3. Dissect the genitalia in a 20% solution of glacial acetic acid to neutralize the KOH. The genitalia can then be washed in 70% ETOH and examined.
4. First instars can now be carefully removed from the abdomen while still in the acid solution.

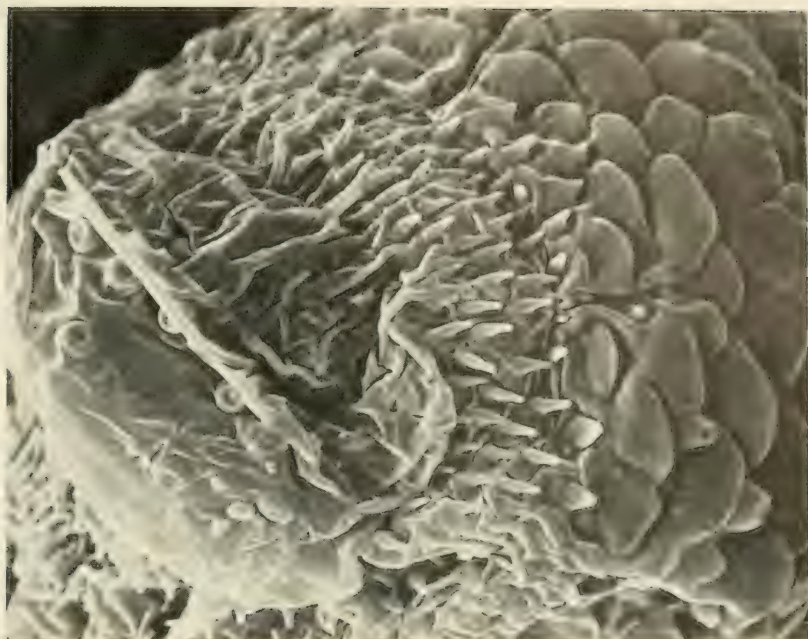


Fig. 1. First instar larva of *Archytas apicifer* (Walker) taken from pinned specimen. Anterodorsal aspect (2,000 $\times$).

5. Following dissection, the abdomen should be dried and reattached to thorax with glue.
6. Larvae can be pipetted from the acid solution and transferred to 70% ETOH and then to a glass microscope slide for mounting.
7. By placing a few drops of carbo-xylol on the specimens, the remaining water can be removed. Draw off the excess carbo-xylol with a small piece of filter paper and mount directly in balsam.

Scanning electron microscope preparations are easily made by following steps 1-5 and then placing the specimens in a porous container to be run through an alcohol series to 100% ETOH. The specimens are then critical point dried and mounted on an SEM stud to be gold coated and observed (Fig. 1).

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Department of Entomology, Michigan State University, East Lansing, Michigan 48824.

NOTE

NEW SYNONYMY IN EPHYDRIDAE (DIPTERA)

Since publication of the catalogue of North American Diptera (Stone et al., 1965, USDA Agr. Hdbk. 276. 1696 pp.), several new genus-group taxa have been proposed in the family Ephydridae. We have included those Nearctic taxa we consider valid in a generic key being prepared for the forthcoming revision of Curran's Manual of Diptera. Our purpose here is to dispense with the generic and species synonymy listed below.

Philygria Stenhammar

- Notiphila* sectio *Philygria* Stenhammar, 1844, K. Vetensk. Akad. Handl. 1843:154. Type-species, *Notiphila flavipes* Fallén, by subsequent designation (Coquillett, 1910, Proc. U.S. Natl. Mus. 37:588).
- Cressoniella* Saether, 1970, Univ. Colo. Stud. Ser. Biol. 31:107 (preoccupied, Mitchell, 1934, Trans. Amer. Entomol. Soc. 59:307, Hymenoptera). Type-species, *Cressoniella montana* Saether (= *P. debilis* Loew), by monotypy. NEW SYNONYMY.

Philygria debilis Loew

- Philygria debilis* Loew, 1861, Berlin Entomol. Ztschr. 5:357.
- Cressoniella montana* Saether, 1970, Univ. Colo. Stud. Ser. Biol. 31:107. Type-loc: Colo., North Boulder Creek, northern branch. Syntypes, 3, Zool. Mus. Univ. Oslo, Norway. NEW SYNONYMY.

Wirth examined the syntypes and found them to be *Philygria debilis* Loew, a species widespread in North America.

Wayne N. Mathis, Department of Entomology, Smithsonian Institution, Washington, D.C. 20560 and Willis W. Wirth, Systematic Entomology Laboratory, IIBIH, Agric. Res. Serv., c o U.S. National Museum, Washington, D.C. 20560.

TEN NEW NORTH AMERICAN SPECIES OF *XYLETINUS*
(ANOBIIDAE: COLEOPTERA)

Richard E. White

Abstract.—Six new species of United States and Canadian *Xyletinus* are described: *californicus*, *carinatus*, *parvus*, *bicolor*, *confusus*, *rotundicollis*. The last three species are closely allied to *X. fucatus* which is redescribed. A key is presented which includes the above six new species and three previously described species that are closely related to them. Four new species of *Xyletinus* from Mexico are described as follows: *aurantiacus*, *mexicanus*, *cylindricus*, *rotundifrons*. A key is given for the five species of this genus now known from Mexico.

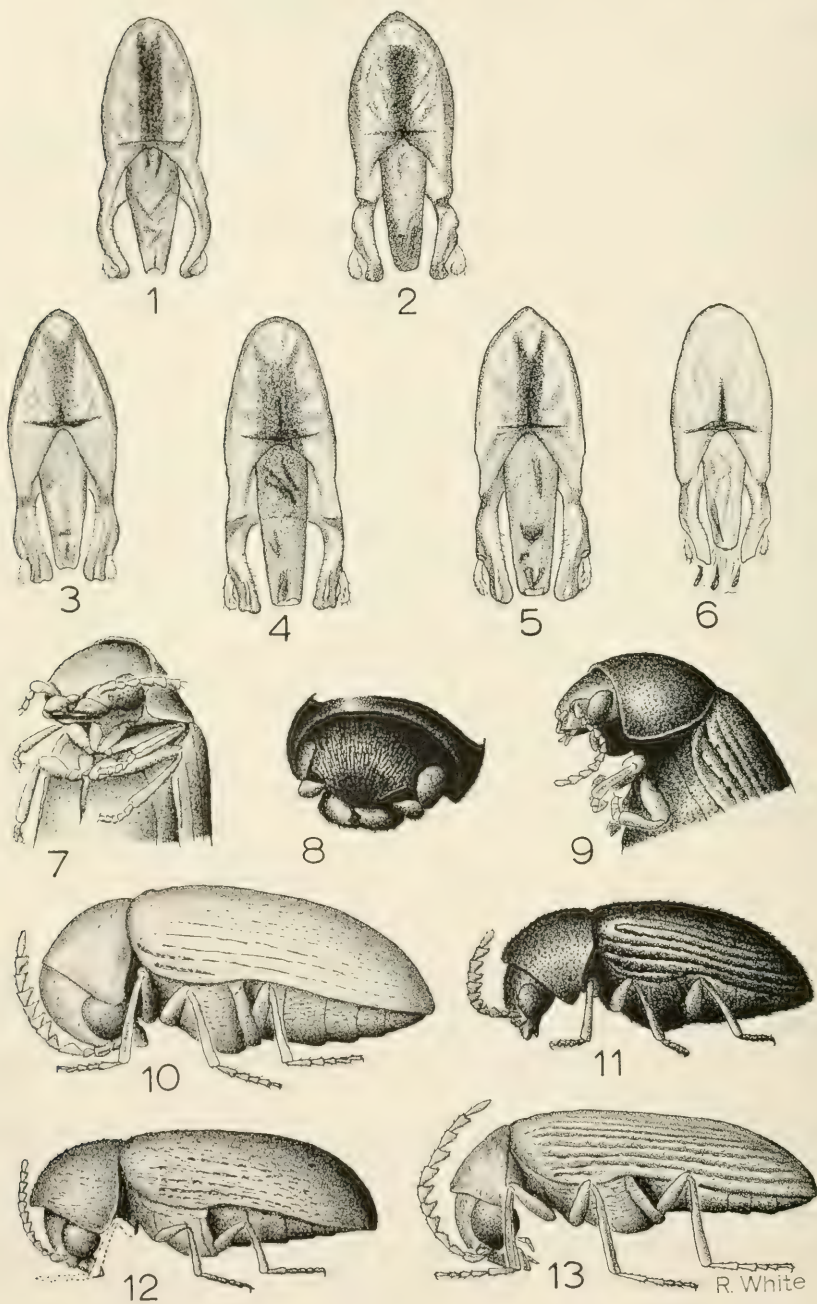
I have encountered some undescribed members of *Xyletinus* in working over unidentified collections of Anobiidae. Six new United States and Canadian and four new Mexican species are described. Three of the United States and Canadian species are members of what I call the *X. fucatus* species complex; work on the latter is just a start toward unraveling this complex. A partial revision of the key appearing in my 1973 paper is given to allow these new U.S. and Canadian species to be identified. A key to the five Mexican species of *Xyletinus* is given. Members of *Xyletinus* are wood borers and thus potentially pests; one species is injurious to woodwork and structural wood in damp buildings.

The first three descriptions are of the more distinctive undescribed United States *Xyletinus* available to me. A treatment of the *fucatus* complex follows these descriptions.

Xyletinus californicus White, new species
(Figs. 4, 9)

General.—Body robust, $1.8\times$ as long as wide, elytral sides broadly arcuate, elytra widest at middle; body and appendages red brown, pronotum and head clouded with dark brown; body and appendages with very short, sparse, appressed pubescence, that on dorsal surface with a weakly reddish luster. Length 3.3–4.4 mm.

Head.—Front moderately, nearly evenly convex throughout to somewhat produced medially between eyes; surface quite densely, more or less finely punctate, punctures varying in size. Eyes small, weakly bulging, in both sexes separated by about $6\times$ frontal width of an eye. Antenna $\frac{1}{3}$ to nearly $\frac{1}{2}$ as long as body, segments 3–10 serrate, segments 4–8 similar, each about as wide as long, segments 9 and 10 each longer than wide. Last segment of maxillary palpus fusiform, about $2\times$ as long as wide; last segment



of labial palpus subtriangular, a little longer than wide, inner angle rounded.

Dorsal surface.—Pronotum a little wider than elytra at base, distinctly, nearly evenly convex throughout; lateral margin complete to nearly complete (1 of 5 specimens), explanate, feebly reflexed; surface finely, densely punctate, punctures larger at side, running together, surface subrugose. Scutellum subtriangular, wider than long, apex rounded. Elytra striate, each elytron with 10 complete, finely impressed, non-punctate striae, weaker apically, plus a short scutellar and 1 (sometimes 2) short subhumeral striae, intervals flat to weakly convex; surface at base finely, densely punctate, punctures on disk running together, surface becoming finely, transversely rugose.

Ventral surface.—Metasternal intercoxal process angulate to arcuate; surface densely, rather coarsely punctate, punctures varying in size. Abdomen with 5th segment of female bearing a small depression before apex, with a tubercle on each side of depression, 5th segment of male with a broader depression, tubercles lacking. Front and middle tibiae with outer face concave, concavity weak to obscure basally; hind tibia with outer face flat nearly throughout.

The male holotype (in CAS) is labeled "Mendocino Co. Cal. IV-30-14, E. R. Leach Coll." The allotype and a female paratype (in USNM) are labeled "Ben Lomond Cal V 1932; L. W. Saylor Collection"; 1 female paratype is labeled "Ben Lomond Cal IV 1931; L. Saylor Collector"; the final paratype (female; in USNM) is labeled "CAL. San Joaquin Co., Lone Pine Canyon, 5-V-1972, W. H. Tyson; Woodrat nest, *Neotoma* sp." Ben Lomond is a town about 50 miles south of San Francisco.

This species is distinctive for having the body and appendages red brown with the head and pronotum clouded with dark brown, and for its markedly convex pronotum that is a little wider at its base than the elytra.

Xyletinus carinatus White, new species

(Fig. 7)

General.—Body elongate robust, about $2.2\times$ as long as wide, sides of elytra subparallel at basal $\frac{1}{2}$; body reddish orange throughout, appendages lighter, dull orange; body and appendages with very short, fine, appressed, yellowish pubescence. Length 2.8–3.3 mm.

←

Figs. 1–6. Male genitalia. 1, *Xyletinus bicolor*. 2, *X. fucatus*. 3, *X. rotundicollis*. 4, *X. californicus*, holotype. 5, *X. confusus*, holotype. 6, *X. lugubris*. Fig. 7, *Xyletinus carinatus*. Fig. 8, *Xyletinus parvus*. Fig. 9, *Xyletinus californicus*. Fig. 10, *Xyletinus rotundifrons*, holotype. Fig. 11, *Xyletinus parvus*, holotype. Fig. 12, *Xyletinus cylindricus*, holotype. Fig. 13, *Xyletinus aurantiacus*.

Head.—Nearly evenly, moderately convex throughout; front feebly, longitudinally carinate; surface indistinctly rugose, rugosities weakly, longitudinally aligned. Eyes small, bulging, separated by $4\times$ frontal width of an eye. Antenna $0.4\times$ as long as body, serrate from segments 3–10, segments 5–8 subequal, segments 9 and 10 slightly more elongated than those preceding. Last segment of maxillary palpus about $2\times$ as long as wide, outer margin nearly straight, inner margin broadly rounded; last segment of labial palpus a little longer than wide, outer margin nearly straight, inner margin very broadly rounded.

Dorsal surface.—Pronotal disk nearly evenly convex, pronotum at side concave; lateral margin produced, sharp, complete, explanate; surface sculpture vaguely granulate punctate, sculpture coarsest at side of pronotum. Scutellum slightly longer than wide, apex rounded. Elytra striate, each elytron with 10 fine, distinct, non-punctate, complete grooves, nearly equally impressed throughout, in addition with a short scutellar, and 1 short subhumeral groove; intervals weakly to feebly convex; surface finely, obscurely, densely punctate throughout.

Ventral surface.—Metasternum at middle with a distinct, longitudinal carina, weaker posteriorly, about 0.4 length of metasternum, metasternum produced to between middle coxae; surface obscurely granulate punctate. Abdomen with surface finely, densely punctate and obscurely granulate; fifth segment nearly flat front to back. Anterior tibia with outer face more or less concave, middle tibia with outer face flat nearly throughout, hind tibia outer face convex.

The male holotype (in CAS) is labeled "CALIF.: Shasta Co., Big Bend, VII-3-65, El. 2,800 feet, R. M. Brown"; 1 paratype (in CAS) is labeled "CALIF. Sisk Co., Fowlers Camp, 5 mi. E. of McCloud, 22-VII-1962; D. C. Rentz, C. D. MacNeill, Collectors"; 1 paratype (in USNM) is labeled "CAL. Eldorado Co., Rubicon River at Georgetown-Ralston road 27.VII.1963; Buckeye Flat, at light; H. B. Leach Collector."

The specific name refers to the metasternal carina. *Xyletinus carinatus* is immediately separable from all other N. American members of *Xyletinus* in bearing this structure. *Xyletinus carinatus* is otherwise similar to *X. fucatus* Lec.

Xyletinus parvus White, new species
(Figs. 8, 11)

General.—Body robust, about $1.9\times$ as long as wide, elytral sides subparallel at basal $\frac{1}{2}$; body dark brown to reddish brown, appendages reddish brown to orange brown; pubescence short, sparse, minutely bristling, weakly yellowish or reddish. Length 2.4 mm.

Head.—Front nearly evenly convex, a little depressed above clypeus; surface longitudinally rugose. Eyes small, weakly bulging, separated by

4.4–5.5× frontal width of an eye. Antenna a little less than $\frac{1}{2}$ as long as body, serrate from segments 3–10, segment 3 a little longer than wide, segments 4–10 wider than long, segment 4 slightly wider than long, segment 7 about 1.6× as wide as long, segment 10 a little wider than long. Last segment of maxillary palpus subcylindrical, about $3\frac{1}{2}$ as long as wide; last segment of labial palpus subtriangular, about 2 as long as wide.

Dorsal surface.—Pronotum as wide as elytra at base, moderately, nearly evenly rounded throughout, at side nearly flat front to back; lateral margin sharp, distinct, complete, minutely recurved; surface finely, densely granulate, granules at side obscurely crescent shaped. Scutellum a little longer than wide, sides subparallel. Elytra with strongly impressed, complete striae, with no evidence of punctures, each elytron with 1 short scutellar, 10 complete, and 1 subhumeral stria, intervals convex; surface irregularly granulate.

Ventral surface.—Metasternal intercoxal process broadly arcuate, surface rather coarsely granulate punctate. Abdomen finely, densely punctate; 5th segment at middle nearly flat front to back, at sides weakly convex before apex. Front and middle tibiae concave apically, hind tibia flat apically.

The male holotype (USNM no. 73688) is labeled "Falls Church, 12.VI.18 Va.; E.A. Chapin Collector; On *Oesnoth americanus*." The generic name may be a misspelling of *Ceanothus*. The single paratype (in CNC) is labeled "Mt. Misery, 4/4/38 NJ, L. Bottimer; Larva coll. in rabbit dung March 1938." The latter collection record is unusual, for other members of this genus are known exclusively as wood borers.

The small size (2.4 mm) and bristling pubescence readily distinguish this species from all others occurring in eastern United States.

Xyletinus fucatus Complex

Fall (1905, p. 202) was correct in stating that a number of different species were included in his taxon *Xyletinus fucatus* Lec. I have seen the type of the latter (MCZ no. 3621, likely a female) and I now restrict the name *fucatus* to light colored specimens. The true *fucatus* is generally recognized by being decidedly lighter in color than other species that have been confused with it. See under *fucatus* (below), the partial key, and the genitalia illustrations for a definition of *fucatus*.

For future work on this group many specimens should be amassed, and numerous dissections of male genitalia should be made. The male genitalia appear to be diagnostic for species, but the differences between 2 similar species are not always obvious. The most important character is the form of the lateral lobes, but the form of the median lobe is important, as is the nature of its internal processes. In working with ex-

tracted genitalia in a liquid (usually alcohol or glycerine) one must force air bubbles out of the median lobe, for they obscure or conceal internal characters.

In my genitalic illustrations (Figs. 1-6), the internal processes of the median lobe show up clearly when, in preparation of the genitalia, I was able to force all or most of the air out of the median lobe.

The three new species are as difficult to identify as any other group of Anobiidae with which I have worked.

Xyletinus fucatus LeConte

(Fig. 2)

General.—Body elongate robust, $2.0-2.1\times$ as long as wide, elytral sides weakly arcuate, elytra widest at about middle; body and appendages nearly unicolorous, orange brown to reddish brown, elytral striae usually dark, elytra infrequently a little darker than remainder of body; body and appendages with very short, fine, moderately dense, weakly yellowish, appressed pubescence. Length 2.8-4.3 mm.

Head.—Front nearly evenly, moderately convex throughout, weakly, longitudinally carinate at middle; surface finely, densely granulate-punctate. Eyes small, separated by $5-6\times$ frontal width of an eye, varying in size but slightly between sexes. Antenna $0.4\times$ to nearly $\frac{1}{2}$ as long as body, serrate from segments 3-10, in female segments 4-9 each a little wider than long, segment 10 about as wide as long, in male segments 5-7 a little wider than in female, segment 9 about as wide as long, segment 10 a little longer than wide. Last segment of maxillary palpus subtriangular, or with sides subparallel, $2\times$ as long as wide; last segment of labial palpus subtriangular, about $1.5\times$ as long as wide.

Dorsal surface.—Pronotum at base as wide as to a little wider than elytra at base; disk moderately, nearly evenly convex, at side shallowly concave; lateral margin sharp, complete, explanate, usually broadly, weakly recurved; surface finely, densely punctate-granulate, punctation most distinct, granulation most obscure on disk. Scutellum about as wide as long, sides subparallel and apex broadly rounded to triangular with apex pointed. Elytron with 10 distinct, complete, impressed striae, and with a scutellar and a subhumeral stria, sometimes laterally with evidence of punctures on striae; intervals moderately to distinctly convex; surface finely, densely granulate-punctate.

Ventral surface.—Metasternal intercoxal process broadly arcuate, surface variably punctate-granulate, coarsest anteriorly. Abdomen with 5th segment sometimes bearing 2 small tubercles before apex; surface finely, densely punctate. Anterior and middle tibiae with outer face concave except basally, hind tibia with outer face flat nearly throughout.

Separation of *fucatus* from related species may be difficult, so following is a resumé of diagnostic characters of *fucatus*. Body and appendages nearly unicolorous, orange brown to reddish brown, elytra infrequently darker than remainder; pronotum at side shallowly concave, with lateral margin usually broadly, weakly recurved; elytral intervals moderately to quite distinctly convex.

Specimens that I have seen are from the following states and provinces (listed east to west): New Brunswick; Quebec; New York; Ontario; Michigan; Wisconsin; Kansas; South Dakota; Saskatchewan; British Columbia; Oregon; California.

Xyletinus bicolor White, new species

(Fig. 1)

General.—Body elongate robust, $1.8-1.9\times$ as long as wide, elytral sides subparallel, weakly widest at about middle. Color variable, usually as follows: Head and metasternum dark brown to black, pronotum dark brown to black and with sides and anterior margins reddish brown, abdomen and elytra brown; body thus often bicolored, but sometimes body brown throughout, sometimes elytral humeri lighter than remainder of elytra; usually with antennae and femora brown, tibiae and tarsi light brown. Body and appendages with short, fine, appressed, weakly yellowish to whitish pubescence. Length 2.7–3.5 mm.

Head.—Front moderately, nearly evenly convex throughout, with a weak, longitudinal carina evident; surface finely, densely granulate punctate. Eyes small, separated by 5 to nearly $6\times$ width of an eye, size in sexes overlapping. Antenna $0.4-0.5\times$ as long as body, shorter in female, serrate from segments 3 through 10, each segment from $6-8\times$ wider than long, 9th segment a little wider than long, 10th segment about as wide as long. Last segment of maxillary palpus subtriangular, about $2\times$ as long as wide; last segment of labial palpus subtriangular, about as wide as long.

Dorsal surface.—Pronotum at base as wide as elytra at base, disk moderately, nearly evenly convex, at side shallowly concave; lateral margin sharp, complete, explanate, broadly, weakly reflexed; disk finely, densely punctate granulate, at side with irregularly developed, rimmed punctures, dorsal rim of each often obscure. Scutellum wider than long to as wide as long, apex broadly rounded. Elytron with 10 distinctly impressed, non-punctate striae plus a scutellar and a subhumeral stria; intervals moderately to weakly convex; surface finely, densely granulate punctate.

Ventral surface.—Metatarsal intercoxal process broadly arcuate, with rimmed punctures (variable in size; largest basally) on a subgranulate surface. Abdominal surface finely, densely punctate and subgranulate. Front

and middle tibiae each with outer face convex apically, flat basally, or flat nearly throughout, each hind tibia with outer face flat nearly throughout.

The holotype (male), allotype, and 8 paratypes (all in CNC except 2 paratypes in USNM) are labeled "Attona Lake, Cut Knife, Sask., 9-VI-1940, A. R. Brooks." A single specimen in this series has the label "Host *Populus tremuloides*." Eight specimens (2 in CNC, 6 in USNM) are labeled "Riding Mt. Pk., Man. VI-9-1937, W. J. Brown." This locality is Riding Mt. National Park. Three additional specimens (in CNC) are labeled essentially the same except for dates, 1 has 15-6-1938, another has 4-VI-1938, and the last has 8-VI-1938. Two specimens (in CNC) are labeled "Elbow, Sask., 23.VI.1954, Brooks-Wallis." Two specimens (1 in CNC, 1 in USNM) are labeled "Chaplin, Sask., 21.VI.1954, Brooks-Wallis." Two specimens (in CNC) are labeled "5 mi. SW. Shilo, Man. 28-V-1958, C. D. F. Miller." Four specimens (2 in CNC, 2 in USNM) are labeled "Ross River, Y.T., 132 30', 61-56', 3,000' 22.VI.60, E. W. Rockburne." Two specimens on 1 pin (in CNC) are labeled "Aweme, Man., R. M. White, 5.VI.1923." Seven specimens (in CNC) with differing data are labeled "Oak Lake, Man., July 9 1953, Brooks-Kelton," "McMurray, Alta. VI-10-53, W. J. Brown," "2 mi. W. Stockton, Man. 26-V-1958, J. F. McAlpine; Spruce-San community," "Assiniboia, Sask. 18.6.1955, A. R. Brooks," "Carberry, Man., June 15 1953, Brooks-Kelton," "Saskatoon, Sask. 7.VII.1949, J. R. Vockeroth," and "Saskatoon, Sask., 2-V-1951, A. R. Brooks."

Of the above characters, the most diagnostic follow: Usually with head and metasternum dark brown to black, pronotum dark brown to black and with sides and anterior margins brown to reddish brown, abdomen and elytra brown; front of head with a weak, longitudinal carina; side of pronotum shallowly concave, lateral margin explanate, broadly, not strongly reflexed, surface with irregularly developed, rimmed punctures, dorsal rim of each often obscure. The male genitalia of this species are distinctive for the narrow, curving lateral lobes that are directed outwardly at the apex.

Although many members of this species have the dorsal surface bicolored as described above, this color alone will not always distinguish the species, for members of *confusus* may be very similar in color.

Xyletinus confusus White, new species
(Fig. 5)

General.—Body elongate robust, 1.9–2.0× as long as wide, sides weakly arcuate, elytra widest at about middle; color much as that of *bicolor*, except light margin of pronotum when present less distinct; body and appendages with short, fine, appressed, weakly yellowish pubescence. Length 2.8–3.7 mm.

Head.—Front moderately, nearly evenly convex, with a weak, longitudinal carina usually evident; surface finely, densely granulate punctate, granulation obscurely, longitudinally aligned. Eyes small, separated by $4.1\text{--}5.4\times$ frontal width of an eye, size in sexes overlapping. Antenna $0.4\text{--}0.5\times$ as long as body, serrate from segments 3–10, segments 5–8 a little wider than long, segment 9 about as wide as long, segment 10 a little longer than wide. Maxillary palpus last segment subtriangular, about $2\times$ as long as wide; labial palpus last segment subtriangular, about as long as wide, inner angle broadly rounded.

Dorsal surface.—Pronotal disk moderately convex, each side of midline often with a weak elevation basally, surface at side shallowly concave; disk finely, densely punctate and subgranulate, with dense, rimmed punctures at side, running together, posterior rim of most punctures obscure; lateral margin sharp, complete, explanate, broadly, weakly reflexed. Scutellum usually wider than long, sometimes about as wide as long, apex broadly rounded. Elytron with 10 distinctly impressed, complete striae, sometimes with vague indication of punctures at sides, also with a scutellar and a subhumeral stria; intervals moderately to weakly convex; surface finely, densely granulate punctate.

Ventral surface.—Metasternal intercoxal process broadly arcuate; surface granulate punctate, most coarsely so near base. Abdomen finely, densely granulate punctate. Front and middle tibiae with outer face concave apically, flat ventrally, middle tibia sometimes flat nearly throughout, outer face of hind tibia flat nearly throughout.

The male holotype and a paratype (both in CNC) are labeled "Banff Natl. Pk., Alta VIII.22.55, W. J. Brown; Eisenhower Junction, 4,700 feet." Four additional paratypes (in USNM) differ only in the date VIII-13-55; 1 specimen (in USNM) differs only in VII-12-55. There are 8 additional paratypes (all in CNC) with differing data as follows: "10 mi. E. of Oliver, B.C., 3-VI-1958, H. & A. Howden"; "Truckee, CALIF., 6,000' Tahoe Co., 14.VII.1961, B. H. Poole" (Truckee is in Nevada Co.); "McMurray, Alta. VI.12.53, W. J. Brown"; "17 mi. NW of Oliver, B.C., 6-VI-1958, H. & A. Howden"; "Norman Wells, N.W.T., VII-3-1949, S. D. Hicks"; "Elkwater, Alta., 11-VI-1956, O. Peck"; "5,400' Flynn Creek, 8 mi. N. Pringle, S.D., VII-8-9, 1961, H. & A. Howden.malt."; and, finally "Orofino Mt., 4,000' nr. Oliver, B.C. VI-8-1958, H. & A. Howden; D. fir." Two paratypes (in USNM) have identical data except 1 has the date June 26–29, the other has July 7–10, 1972, the identical data are: "Stratton Expt. Watershed nr. Saratoga, Wyo., J. M. Schmid; LIT-2; HOPK. U.S. 36774-F."

The most diagnostic of the above characters follow: Color much as that of *bicolor* except light margin of pronotum when present less distinct; front of head with a weak, longitudinal carina, surface granulation obscurely, longitudinally aligned; sculpture at side of pronotum of dense,

rimmed punctures, running together, posterior rim of most punctures obscure; lateral pronotal margin broadly, weakly reflexed.

Xyletinus rotundicollis White, new species
(Figs. 3, 10)

General.—Body elongate-robust, 1.8–2.0× as long as wide, elytral sides weakly arcuate, elytra widest at about middle; usually head, pronotum and metasternum black and abdomen and elytra dark brown to dark reddish brown, antenna brown, femora dark brown, tibiae and tarsi brown, sometimes black nearly throughout, or black with elytra brown to dark reddish brown, antenna brown, femora dark brown, tibiae and tarsi brown, sometimes black nearly throughout, or black with elytra brown to dark reddish brown, often with anterior and or lateral margins of pronotum reddish brown; body and appendages with very fine, very short, moderately dense, appressed pubescence, that on dorsal surface with a primarily reddish reflection, that on ventral surface with a yellowish reflection. Length 2.7–3.7 mm.

Head.—Front nearly evenly, moderately convex throughout, not carinate; surface finely, densely punctate to subgranulate, punctures varying in size, infrequently clearly dual. Eyes small, separated by 4–6× transverse diameter of an eye. Antenna about $\frac{1}{3}$ to nearly $\frac{1}{2}$ as long as body, serrate from segments 3–10, segment 3 longer than wide, segments 4–8 wider than long, segment 9 as wide as long or longer than wide, segment 10 longer than wide, segment 11 about 2× as long as wide. Last segment of maxillary palpus subtriangular, widest beyond middle, about 2× as long as wide; last segment of labial palpus subtriangular, inner angle broadly rounded, about as wide as long.

Dorsal surface.—Pronotum at base as wide as elytra at base; pronotum distinctly, nearly evenly convex throughout, even to extreme side; lateral margin sharp, complete, explanate at level of hind angle, sometimes weakly reflexed; disk with fine, dense punctation, punctures toward side becoming larger and coarse, running together, obscurely dual, surface subgranulate. Scutellum a little wider than long, apex broadly rounded. Elytron with 10 strongly impressed, complete striae, striae with little to no evidence of punctures, also with 1 sutural and 1 subhumeral stria; intervals clear convex at side, nearly flat on disk; surface finely, densely granulate.

Ventral surface.—Metasternal intercoxal process broadly arcuate, surface with dense punctation, obscurely dual, subgranulate, especially anteriorly. Abdominal punctation fine, dense, obscurely dual. Front and middle tibiae with outer face concave apically, flat basally, outer face of hind tibia weakly flattened.

The male holotype (no. 73689 in USNM) is labeled "Turner, East Lake Cal, Rec. June 21.83; Through C. V. Riley," the allotype (in USNM) is labeled "Mather Toulmne (sic) Co, California, VIII-18-32; Colln E. C. Zimmerman, 1941."

A male paratype (in CNC) is labeled "Richter Pass Rd., 7 mi. W. Osoyoos, B.C. 2-VI-1958, H. & A. Howden"; a female paratype (in CNC) has essentially the same except for no mile designation, and the date V-30-1958. Three male paratypes with differing data (first 2 in CNC, last in USNM) are labeled "Val Marie, Sask., 49°15', 107°44', 13.VI.1955, J. R. Vockeroth," "Naramata, B.C., V.28 1958, H. & A. Howden; Sage brush," and "Boulder, Colo., 16.VI.61 6,400', B. H. Poole." There are 16 additional paratypes, the first 5 are in CNC, the last 11 in USNM, their data follow: "7 mi. N. of Oliver, B.C., V-26-1958, H. & A. Howden"; "Summerland, May. 30.32 B.C., A. N. Cartrell"; Bridgeville, Calif. 20.VI.69, Kelton & Madge"; "15 mi. N. Burns Ore., June 8, 1955, Joe Schuh Collector"; "Scandia, Alta., VIII-9-1956, O. Peck"; "Oliver, B.C., 13.V.1959, E. E. MacDougall"; "Kings Canyon, Cal. 6-23-1955, PS Bartholomew; P. S. Bartholomew Coll. Calif. Acad. Sci., Accession 1967"; "Yosemite, Cal. 7-4-49 PSB; P. S. Bartholomew Collection Calif. Acad. Sci. Accession 1967"; "Carmel, Monterey Co., June 14, 1908 Cal; L. S. Slevin Collection"; and "Twin Lakes, Mono Co. Cal, July 1929; 3411"; "Sweeping alfalfa Oroville Wn., 6-5-1919, A. C. Burrill"; "CAL. Shasta Co., Lake Britton, VI-29-1947, H. Chandler; H. P. Chandler Collection"; "Topenish, Wn, IV-24-1925, M. C. Lane Co."; three final paratypes are labeled "Easton, Wash. K.; A. Koebele Collector."

The most important diagnostic characters of this species follow: Usually head, pronotum and metasternum black and abdomen and elytra dark brown; surface of head finely, densely punctate to subgranulate, punctures varying in size; pronotum distinctly, nearly evenly convex throughout, even to extreme side; pronotal disk with fine, dense punctation, toward side, punctures becoming larger, coarse, and running together, obscurely dual, surface subgranulate.

The specific name (meaning round hill) refers to the nearly evenly convex side of the pronotum.

The following key replaces the last part of my key to North American *Xyletinus* species (White, 1973, p. 81) and includes the six new species described above.

Partial Key to North American Species of *Xyletinus*

- 12(11). Dorsal surface and head with short, bristling hairs, see Fig.
11
- Dorsal surface and head with appressed pubescence 14
- 13(12). Length 2.6-3.5 mm; Texas *pubescens*, LeConte

- Length 2.4 mm; eastern U.S. *parvus*, new species
- 14(12). Metasternum anteriorly at middle with a carina; California *carinatus*, new species
- Metasternum lacking a carina; various localities 15
- 15(14). Body reddish brown, pronotum clouded with dark brown; pronotum at side distinctly convex (Fig. 9); California *californicus*, new species
- Body usually dark brown to black, if reddish brown to nearly orange then side of pronotum shallowly concave; various localities 16
- 16(15). Body orange brown to reddish brown throughout; male genitalia Fig. 2 *fucatus* LeConte
- Body nearly always dark brown to black, at least in part; male genitalia Figs. 1, 3, 5, 6 17
- 17(16). Antennal segments each about 2× as wide as long (female) or about 3× as wide as long (male); eastern U.S. to Nebraska and Alberta; male genitalia Fig. 6 *lugubris* LeConte
- Antennal segments as wide as long to a little wider than long; Manitoba and South Dakota to California 18
- 18(17). Pronotum at side nearly evenly convex, lateral margin weakly, narrowly reflexed, similar to Fig. 9; male genitalia Fig. 3; head lacking a median carina *rotundicollis*, new species
- Pronotum at side broadly, shallowly concave, lateral margin broadly, weakly reflexed; male genitalia Figs. 1, 5; head with a weak, longitudinal carina 19
- 19(18). Sculpture at side of pronotum of dense, rimmed punctures, dorsal rim of each often obscure; male genitalia with lateral lobes narrow and arcuate (Fig. 1) *bicolor*, new species
- Sculpture at side of pronotum of dense, rimmed punctures, posterior rim of each often obscure; male genitalia with lateral lobes broader, less arcuate (Fig. 5) *confusus*, new species

Mexican *Xyletinus*

Descriptions of new Mexican species and a key to the five species occurring in Mexico follow.

Xyletinus aurantiacus White, new species (Fig. 13)

General.—Body elongate, robust, about 2.3× as long as wide, sides of elytra subparallel for basal ⅓; ground color of body and appendages reddish orange, head and portions of ventral surface often clouded with brown; body and legs clothed with fine, short, appressed, moderately dense, orange

pubescence, with a sheen in light; body surface finely, densely granulate. Length 3.2–4.0 mm.

Head.—Distinctly, nearly evenly convex throughout, front vaguely, longitudinally produced between eyes. Eyes large, bulging, separated by 2.1–2.6× frontal width of an eye. Antenna about 0.65× as long as body, serrate from segments 3–10, segment 3 widest medially, about 2× as long as wide, segments 4–7 similar, segments 8–10 more elongate, each longer than wide, 10th most elongate, 11th segment nearly 4× as long as wide, widest before apex. Last segment of maxillary palpus subcylindrical, about 4× as long as wide; last segment of labial palpus elongate, tapering to apex, about 3× as long as wide.

Dorsal surface.—Pronotal disk with a median basal gibbosity and on each side 2 lateral gibbosities, these moderately developed, surface at side convex; lateral margin complete, sharp, narrowly explanate. Scutellum a little longer than wide, narrowed apically, apex rounded. Elytra with 10 complete, irregularly impressed striae, with scattered evidence of punctures, also with a scutellar and a subhumeral stria, intervals weakly convex.

Ventral surface.—Metasternal intercoxal process broadly angulate. Abdomen with 5th segment feebly depressed before apex. Front tibia with outer face concave nearly throughout; middle tibia with outer face flattened; hind tibia with outer face weakly flattened; tarsi long, each nearly as long as its tibia.

The male holotype and a paratype (in CAS) are labeled "MEX.B.Calif., 2 mi. NE. of El Rosario, 7-XII-1958; H. B. Leech Collector." Three paratypes (in CAS) are labeled "MEX.: Baja Calif., 7 mi. NNW. Rosarito, 8-9.IV.1961, Allyn G. Smith"; two paratypes (in USNM) are labeled "Mezquital, BAJA CALIF., VIII-25-1959. lt. trap., K. W. Radford & F. G. Werner."

This species is quite distinctive for the much reduced pronotum and the very elongate tarsi, see Fig. 13. The species name refers to the orange color.

Xyletinus cylindricus White, new species
(Fig. 12)

General.—Body elongate robust, about 2.4× as long as wide, sides of elytra subparallel for about basal $\frac{1}{2}$; body reddish brown, head and pronotum mostly dark brown, antennae and tarsi lighter than remainder; body with fine, short, mostly appressed, greyish pubescence, weakly bristling on head and pronotum. Length 3.1 mm.

Head.—Nearly evenly, moderately convex throughout, not carinate; surface finely, densely granulate. Eye size moderate, eyes bulging, separated by about 3× frontal width of an eye. Antenna about $\frac{1}{2}$ length of body.

serrate from segments 3-10, segments 3-4 each about $2\times$ as long as wide, segments 5-8 each about as wide as long, segments 9 and 10 longer than wide, segment 11 about $2\times$ as long as wide. Last segment of maxillary and labial palpi similar, fusiform, each about $2\times$ as long as wide.

Dorsal surface.—Pronotum distinctly, nearly evenly rounded throughout; lateral margin sharp, complete, narrowly produced; surface sculpture of minute granules and intermixed larger granules. Scutellum about as long as wide, apex broadly rounded. Elytra striate, each elytron with 10 more or less distinct striae, 1 scutellar and 1 subhumeral stria, striae irregularly impressed, most distinct at sides, intervals nearly flat; surface finely, densely granulate.

Ventral surface.—Metasternal intercoxal process arcuate, metasternal surface finely, densely granulate. Abdomen with 5th segment nearly flat front to back; surface sculpture of fine, dense granules. (Front legs missing); middle tibia with outer face more or less flattened; hind tibia with outer face not flattened.

The female holotype (in CAS is labeled "MEXICO: Sonora, Tastiota, VII-18-1950; Col. by J. P. Fig-Hoblyn.")

This species differs from other Mexican *Xyletinus* in the weakly serrate antennae, the cylindrical body shape, relatively small eyes, and minute, bristling hairs on the head and pronotum.

Xyletinus mexicanus White, new species

General.—Body elongate robust, $2.3-2.4\times$ as long as wide, sides of elytra subparallel for about basal $\frac{3}{4}$; body and legs reddish brown, antennae orange brown, various body regions (except elytra) sometimes clouded with dark brown; body with short, fine, dense pubescence, appressed throughout to minutely bristling in part, obscuring surface, pale tan, with a sheen in light. Length 3.9-4.3 mm.

Head.—Nearly evenly, moderately convex throughout, not carinate; surface finely, densely granulate, granules obscurely of 2 sizes. Eyes very large, bulging, separated by $1.4-2.0\times$ frontal width of an eye. Antennae about $\frac{1}{2}$ length of body, serrate from segments 3-10, segment 3 about $1.5\times$ as long as wide, segment 4 a little longer than wide, segment 5-8 with similar proportions, segments 9 and 10 each about $2\times$ as long as wide, segment 11 about $3\times$ as long as wide. Last segment of both maxillary and labial palpi elongate-fusiform, each about $3\times$ as long as wide.

Dorsal surface.—Pronotum distinctly, nearly evenly rounded throughout, at side distinctly convex; lateral margin sharp, distinct, complete, very narrowly produced, in side view nearly evenly arcuate; surface with fine, dense granulation, granules of 2 sizes. Scutellum about as wide as long, apex broadly rounded. Elytra usually distinctly striate, striae of elongate,

usually well-aligned punctures, striae strongest at side of elytra; intervals weakly convex; surface very finely, densely granulate.

Ventral surface.—Metasternal intercoxal process nearly straight across or minutely angulate; surface finely, densely granulate. Abdomen with 5th segment nearly flat front to back; surface finely, densely granulate. Front tibia with outer face flat nearly throughout; middle tibia with outer face mostly flat; hind tibia outer face not flattened.

The male holotype (in CAS) is labeled "Coronados I., Gulf Calif., May 18, 1921; EPVanduzee Collector; Ed. 3596." One paratype (in CAS) is labeled "Porto Ballandra; Carmen Isd., Gulf Calif., May 21, 1921; EPVanduzee Collector"; 2 paratypes (1 in CAS; 1 in USNM) are labeled "Mezquital, BAJA Calif., VIII-25-1959. Lt. trap. KWRadford&FGWerner"; the final paratype (in USNM) is labeled "Venancio, L. Cal. VII-17-38; Michelbacher & Ross Collectors."

This species is quite similar to *X. mucoreus mucoreus* Lec., the differences follow: In *mucoreus mucoreus* the pubescence is distinctly bristling in part, the metasternal intercoxal process is deeply, distinctly angulate, the length is 3.4–6.2 mm, and the lateral margin of the pronotum is sinuate in lateral view; in this species the pubescence is appressed throughout to minutely bristling in part, the metasternal intercoxal process is minutely angulate, the length is 3.9–4.3 mm, and the lateral margin of the pronotum in lateral view is nearly evenly arcuate. The head beneath in *mexicanus* is less distinctly depressed, and the palpi are much more elongated than in *mucoreus mucoreus*. In addition, *mucoreus mucoreus* occurs from Florida to Texas and this species occurs in Lower California.

Xyletinus rotundifrons White, new species
(Fig. 10)

General.—Body elongate robust, about $2\times$ as long as wide, sides of elytra subparallel for basal $\frac{3}{4}$; body and appendages orange brown, antennae palest, head and pronotum vaguely clouded with brown; body and legs clothed with fine, moderately dense pubescence, with a dull yellowish sheen in light. Length 4.4 mm.

Head.—Quite strongly, nearly evenly convex throughout; surface finely, densely punctate. Eyes large, bulging, separated by $2.8\times$ frontal width of an eye. Antenna nearly $\frac{1}{2}$ as long as body, serrate from segments 3–10, segment 3 about $2\times$ as long as wide, segment 4 about as wide as long, segments 5–8 subequal, each about $\frac{1}{2}$ wider than long, segments 9 and 10 subequal, each a little longer than wide, 11th segment about $4\times$ as long as wide. Last segment of maxillary palpus elongate, subcylindrical, about $4\times$ as long as wide; last segment of labial palpus elongate, widest near base, about $3\times$ as long as wide.

Dorsal surface.—Pronotal disk distinctly convex, less strongly so anteriorly, at side strongly convex, surfaces before posterior angle and behind anterior margin depressed; lateral margin sharp, complete, slightly produced; surface finely, densely punctate. Scutellum subtriangular, a little wider than long, apex narrowly rounded. Elytra striate, each elytron with 10 fine, complete, distinctly impressed grooves, with indistinct evidence of punctures, with a short scutellar and subhumeral stria, last and subhumeral striae very strong at base; intervals nearly flat; surface finely, densely granulate-punctate, sculpture sometimes forming transverse rugulae.

Ventral surface.—Metasternal intercoxal process broadly angulate; surface of metasternum finely, densely punctate-granulate, sculpture in places forming rugulae. Abdomen with surface finely, densely punctate granulate throughout; 5th segment nearly flat front to back. Anterior tibia with outer face flat nearly throughout, middle tibia weakly flattened, hind tibia not flattened.

The female holotype (in CAS) is labeled "Pto Refugio, Gulf Calif., May 1, 1924; Angel de la Guardia Isd; EPVanDuzee Collector."

This species is distinctive for the quite strongly, nearly evenly convex head; the species name refers to this character.

Key to Species of Mexican *Xyletinus*

1. Elytral striae formed of distinct, sometimes much elongated punctures 2
 - Elytral striae formed of impressed grooves, these sometimes obscurely punctate 4
- 2(1). Antenna weakly serrate (Fig. 12); eyes smaller, separated by about 3× vertical diameter of an eye *cylindricus*, new species
 - Antenna more strongly serrate; eyes larger, separated by 1–2× vertical diameter of an eye 3
- 3(2). Length 1.9–4.1 mm; pubescence sparse; body reddish orange to orange brown *pallidus* LeConte
 - Length 5.2–5.4 mm; pubescence dense; body brown *mexicanus*, new species
- 4(1). Head large and markedly convex; pronotum normal in size (Fig. 10); pubescence silvery *rotundifrons*, new species
 - Head not as above; pronotum reduced in size (Fig. 13); pubescence orange *aurantiacus*, new species

I thank the following persons for loans: Dr. Edward C. Becker, Canadian National Collection (CNC), Ottawa; Dr. David Kavanaugh, California Academy of Sciences (CAS). The initials are used in the text in referring to sources of material. The initials USNM refer to the United States National Museum of Natural History.

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NOTE

A NEW SYNONYM AND LECTOTYPE DESIGNATION
IN EPHYDRIDAE (DIPTERA)

The purpose of this note is to clarify the nomenclature of, and to designate a lectotype for *Notiphila solita* Walker. I am doing this now so that the proper name will be used in a forthcoming paper on the biology of this species prepared by Mr. J. D. Busacca and Dr. B. A. Foote, Kent State University, Ohio.

Notiphila solita Walker

Notiphila solita Walker, Insecta Saund., 1852:406. LECTOTYPE ♂ (here designated) (BM(NH)), labelled: "68·4 US solita/United States. W. W. Saunders. B.M. 1868-4 LECTOTYPE *Notiphila solita* Walker by W. N. Mathis."

Notiphila vittata Loew, Smithson. Misc. Coll. 1862, 6(141):136. Holotype ♀, (MCZ), labelled: "Dista-Columb. Loew Coll. vittat. ♀ Type 11127." NEW SYNONYMY.

Through the courtesy of Mrs. Janice C. Scott (MCZ) and Dr. Brian H. Cogan (BM(NH)), I have studied both of the specimens indicated above to confirm their conspecificity.

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ETHOLOGY OF *CEROTAINIA ALBIPILOSA* CURRAN
(ASILIDAE: DIPTERA) IN MARYLAND: DIURNAL ACTIVITY
RHYTHM AND SEASONAL DISTRIBUTION¹

Aubrey G. Scarbrough and Arnold Norden²

Abstract.—The diurnal activity pattern and seasonal distribution is described for *Cerotainia albipilosa* Curran in Maryland. This woodland species directed its activities from plant perches along sunlit margins of paths and clearings. Various behaviors were initiated about 8:30 AM and continued until about 7:00 PM. Adults flew from perches about one time per 1.5–2.5 min although the frequency of any flight was related to the type of activity and time of day. Most behaviors were conducted at one perch for about 10–15 min, and then the asilid flew to a new perch where the behavior was continued. New perches were usually within three meters of the previous one. Foraging flights and feedings occurred throughout the day although females were more active than males. Males foraged almost exclusively from 10:00 AM to 1:30 PM and 5:00 to 7:00 PM. Both sexes hovered in front of a perch while manipulating prey. Search and courtship flights of males began by 10:00 AM and continued until 6:00 PM. Mating occurred between 11:30 AM and 4:30 PM. Temperature, lighting conditions and high winds influenced flight and related behaviors. *Cerotainia albipilosa* was present in study sites from early July to September.

The genus *Cerotainia* is restricted to the New World with most species (25) reported from South America (Hull, 1962). Only three species are reported from North America: *C. albipilosa* Curran and *C. macrocera* (Say) from several east coast and midwestern states and *C. atrata* Jones from Nebraska (Bromley, 1934, 1937; Martin and Wilcox, 1965; Baker and Fisher, 1975). Of the three species, *C. macrocera* has a reported wider distribution. *Cerotainia macrocera* (McAtee and Banks, 1920) and *C. albipilosa* (as *macrocera*: Scarbrough, 1974) have been reported from Maryland. Wilcox has records of both species from Maryland and west to Kansas and Oklahoma (personal communications, 20 May 1975). The genus is associated with tips of leaves and twigs along sunlit margins of thickets, trails in woods and forest-field interfaces (McAtee and Banks, 1920; Fattig, 1945; Bromley, 1950; Goslin, 1950; Scarbrough, 1974).

While conducting another study on woodland asilids, one of us (AGS) found an unusually large population of adult *C. albipilosa* at the Loch Raven Watershed in Baltimore County, Maryland. Other than the general predaceous habit and collecting records of adults, nothing is known of the species. This fly is ideal for study under field conditions since aggregates of

the fly population are concentrated in small sunlit clearings, and individual flies are not easily disturbed and often utilize single perches for long periods. Males can be recognized in the field by ashy-white pollin and pile on the head and silvery-white hairs on the dorsum of the thorax and abdomen; females have slightly yellowish pollin and pile on the head and black dorsal abdominal hairs (Curran, 1930).

Methods and Materials

This field study encompassed a total of 135 days spent in the field during the period from 29 June to 6 September 1972-75. Summers of 1972 and 1973 were used to ascertain various aspects of the general biology and behavior patterns of the species and to determine its seasonal distribution and abundance. This preliminary work assisted in development of relevant behavior codes and recognition of temporally pertinent elements of the species biology for future reference. Most aspects of the adult's biology were examined in the summers of 1974 and 1975, and it is from this work that much of the quantitative results presented here are based.

We attempted to obtain a complete diurnal activity schedule of the adult fly. Two general approaches were utilized: 1) activities of many different flies were observed by slowly walking through observation sites. This technique has the advantage of quantifying general diurnal activities of the population and 2) single flies were under surveillance for periods of 30 min or more when possible. This has the advantage of yielding considerable quantitative information of individual behaviors unobtainable in the former method (Lavigne and Holland, 1969). Observations were made in several sunlit clearings since a single site did not remain sunlit continuously during the day. Temperature and relative humidity recordings were taken in sunlit sites about 1.2 m above the ground. The curves in the figures are based upon averages of recordings taken during the observation periods.

Information of individual behaviors associated with the diurnal rhythm was obtained by recording activities of ten or more flies of each sex for each hour of the observation period. Observations were taken under bright skies from 7:00 AM to 7:00 PM between 20 July and 30 August 1975. Flies to be observed were predetermined by selecting a number before entering a clearing. This procedure avoided the danger of observing only conspicuous behavior. The following defined behaviors were recorded: 1) foraging flights involved flight activity directed toward a potential prey. These flights were recorded a success if the asilid returned to a perch with a prey impaled upon its proboscis and unsuccessful if it returned without a prey. In the latter the predator may or may not come in contact with the prey in flight. 2) Rotation flights involved a fly hovering in front of a perch, manip-

ulating a prey. This flight occurred in association with the feeding process. 3) Change of perches include short flights within observation sites which allowed the asilid to 'observe' its surroundings and to change its field of vision (orientation flights of Dennis and Lavigne, 1975; experimental darts or flights of Melin, 1923). These flights occurred following changes in total sunlit space within observation sites and various disturbances produced by animals, falling objects and climatic conditions. 4) Agonistic flights involved aggressive interactions of males-to-males and females-to-males during courtship. 5) Searching flights consisted of rapid-darting flights along margins of observation sites by males in search of receptive females with which to mate. These flights terminated in the vicinity of perched females. 6) Courtship flights consisted of males hovering in front of perched females. This flight pattern is used in this study to denote a specific behavior which conveys a message to a member of the opposite sex, and may lead to mating.

Seasonal distribution and abundance of *C. albipilosa* were determined by collecting adults with an aerial net along a standard route of 2.4 km. The route was located in a section of the woods some distance from observation sites. Collections were made at three four-day intervals during periods of good weather, and usually between 10:30 AM and 12:00 PM. Most adults observed along the route were captured on each collecting day. Data obtained from two successive collecting days were combined and plotted on a weekly basis.

Study area.—*Cerotainia albipilosa* was studied in sunlit clearings along footpaths and forest-field interfaces at the Loch Raven Watershed (Baltimore Quadrangle, 39 27'3"N, 76 32'45"E) in northern Baltimore County, Maryland. The topography of the study area slopes upward from a wet lowland semi-open woods bordering a stream to a dry mesophytic upland woods. Several hiking trails transect these woods, exposing numerous sunlit clearings that are frequented by a large number of asilid species (Scarborough, 1974). Undergrowth through much of the woods is impassable, especially along the lowland paths and margins of small clearings. The soil is usually sandy although red clay outcroppings are common near the hilltops. Dominant plants at observation sites are as follows: *Solidago altissima* L., *Dacus carota* L., *Rhus glabra* L., *Aster* spp., *Poa* spp., *Lonicera morrowi* Gray, *L. japonica* Thunberg, *Rubus* spp., *Quercus* spp., *Pinus* spp., *Lendera benzoin* L. and *Liriodendron tulipifera* L.

Results and Discussion

Diurnal rhythm of activity.—Adults of *Cerotainia albipilosa* conducted all diurnal activities from tips of leaves, small branches or dead twigs projecting from plants along margins of sunlit paths or clearings. When perched, the long axis of the body was either parallel to the substrate or



Fig. 1. Typical perch position of a female *Cerotainia albipilosa* on the tip of a branch.

at a variable angle to it (Fig. 1). The asilid's body was often tilted forward or the head was angled slightly downward presumably to detect movement below or at the level of the perch. Wings were folded above or spread at an angle of about 45–60° to the sides of the body. In this position the fly usually faced the sun and the open space in front of the perch.

The diurnal rhythm of activity of *C. albipilosa* is presented in Figs. 2 and 3. Flies, involved in no apparent flight activity, were perched near tops of sunlit trees by 8:00 AM. Their bodies were angled slightly downward and perpendicular to the sun's rays. Grooming was frequent at this time. Presumably this behavior allowed *C. albipilosa* to maximize

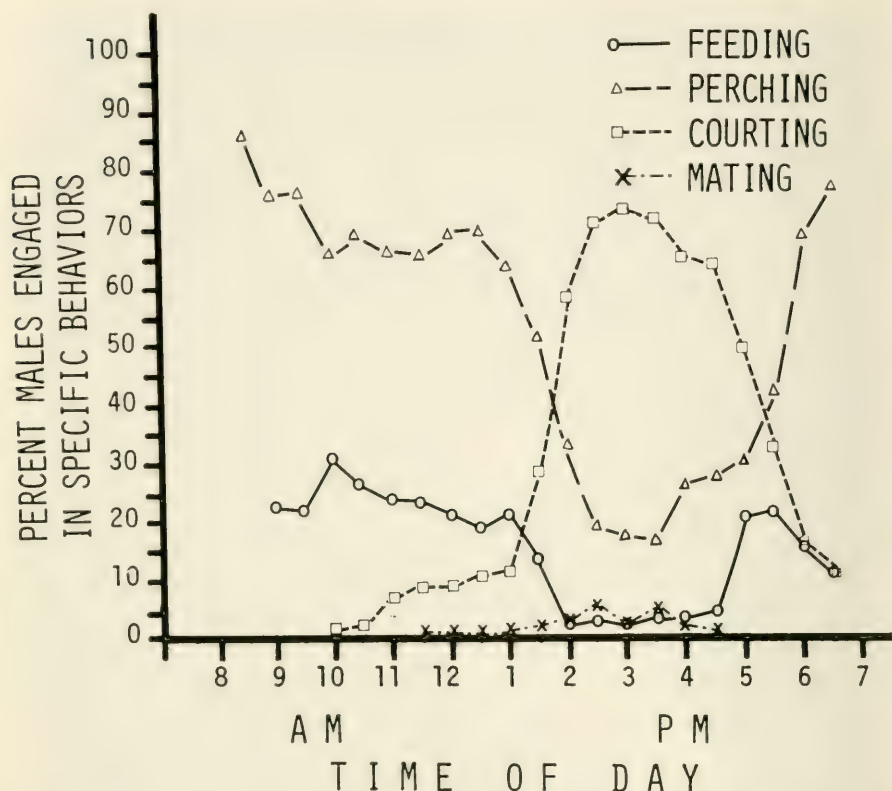


Fig. 2. The mean diurnal rhythm of activity of male *Cerotainia albipilosa* at the Loch Raven Watershed in Baltimore County, MD.

heat absorption and to enhance evaporation of moisture from their body surfaces. Temperatures and relative humidities between 8:00 and 8:30 AM were 25°C (R20–26) and 83% (R64–98), respectively (Fig. 4). Behaviors associated with flight began a few minutes ($\bar{x}$ 17, R5–35) after the asilids appeared at observation sites and continued until sites became shaded (6:45–7:00 PM). Consequently, incidence and duration of inactivity at perches decreased correspondingly as various behaviors increased during the day. Both sexes fed throughout the day although males showed a temporary decrease in early and mid-afternoon. Males courted females between 10:00 AM and 6:00 PM with a peak period between 1:00 and 6:00 PM. Mating occurred between 11:30 AM and 11:30 PM although most were observed between 11:30 and 4:00 PM. Air temperature and relative humidities averaged 31°C (R30–32) and 26% (R25–27), respectively, during this period. Times of peak courtship and mating activities cor-

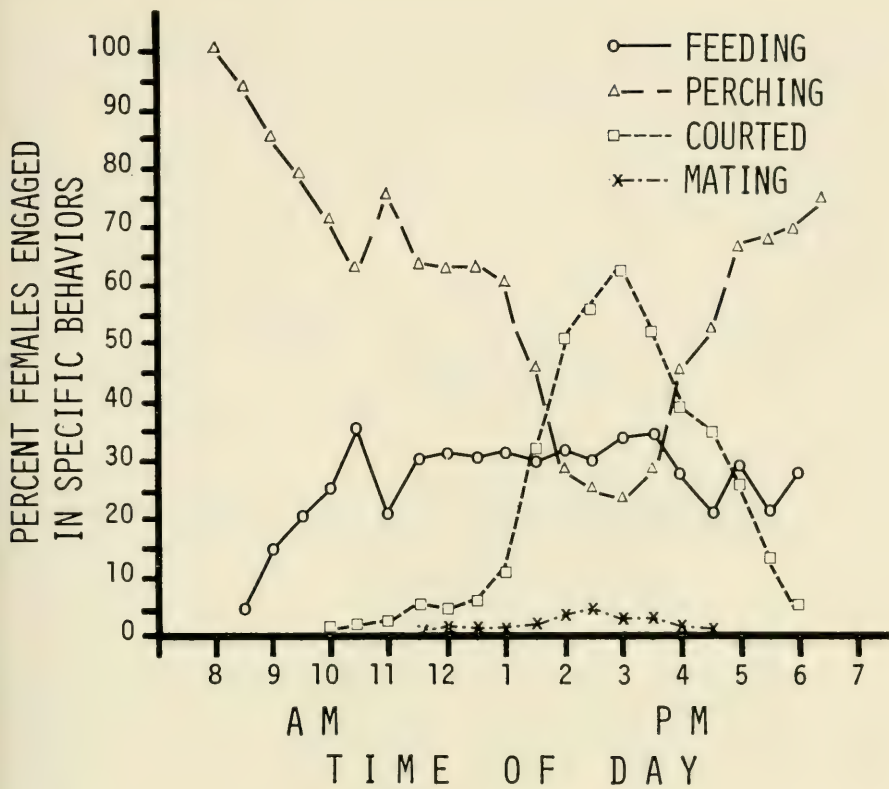


Fig. 3. The mean diurnal rhythm of activity of female *Cerotainia albipilosa* at the Loch Raven Watershed in Baltimore County, MD.

responded to times of decreased feeding activity by males. In late afternoon, feeding activities decreased as adults remained perched for longer periods. Shortly after 7:00 PM, adults flew out of sight into the surrounding vegetation. Air temperatures and relative humidities were 26°C (R23–33) and 61% (R59–69), respectively. All observation sites were dark by 7:30 PM.

Diurnal flight activity.—The diurnal vertical migration of *C. albipilosa* is presented in Table 1. These observations were taken during a ten day period between 6 and 16 August 1975. During periods of maximum flight activity (10:00 AM–5:00 PM), the population in observation sites utilized perches at heights ranging from a few cm above ground level up to about nine m. However most flies were concentrated on perches within three m of ground level. This period corresponded with times of maximum sunlit perches at these heights. Perching at higher heights occurred at times

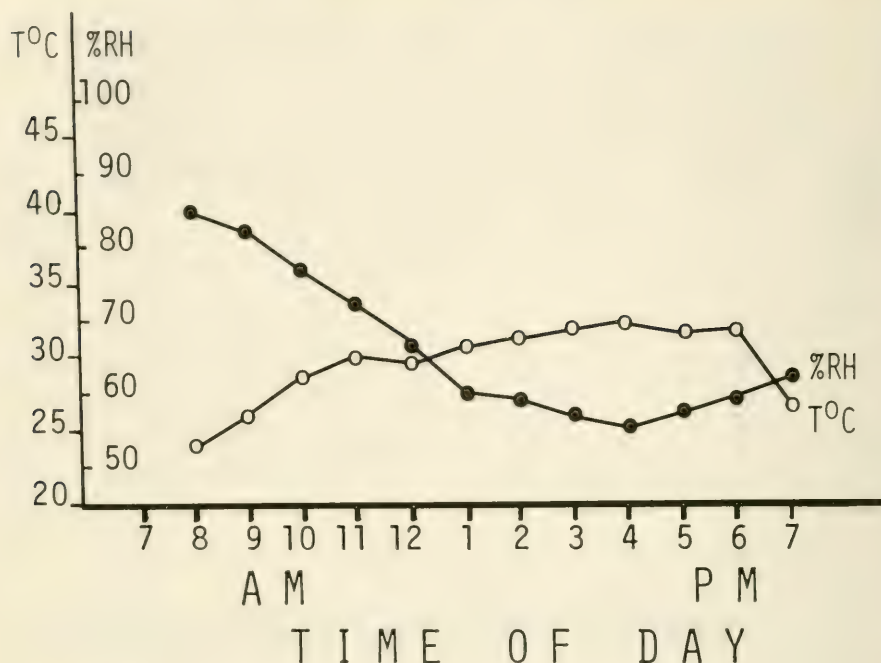


Fig. 4. Mean temperatures and relative humidities during the observation periods at the Loch Raven Watershed in Baltimore County, MD.

when sites near ground level were shaded or during overcast periods and days. When perches became shaded, flies moved horizontally or vertically to new sunlit perches along margins of observation sites. During inclement weather and at night, they moved into surrounding vegetation, perching below leaves and branches or in cracks of tree bark. Similar vertical migrations of asilids have been reported by Adamovic (1963), Lavigne (1970) and Musso (1972).

Recognized flight activities of *C. albipilosa* are presented in Figs. 5 and 6 and Tables 2 and 3. Flights were not initiated until temperatures exceeded 20°C. Adults flew from perches about one time per 1.5–2.5 min ($\bar{x}$ 1.6, σ 1.2, η 1.2) although the frequency of any flight was related to the type of activity and time of day. Most flights were of short duration ($\bar{x}$ 3 sec, 2–6) and usually within three m of perches. Searching flights by males and flights resulting from disturbances were frequently longer. *Cerotainia albipilosa* usually returned to the original perch following each flight.

Cerotainia albipilosa moved to new perches about every 10–15 min ($\bar{x}$ 10.1, σ 1.5, η 1.5) during the diurnal activity period (Tables 2, 3). However adults involved in foraging and courtship flights frequently utilized single

Table 1. Diurnal vertical migration of *Cerotainia albipilosa* along margins of sunlit clearings during the summer of 1975.

Height in meters	Percent individuals per hour											
	AM				PM							
	8	9	10	11	12	1	2	3	4	5	6	7
15	25.0	11.1									11.5	42.0
12	31.2	16.7	2.8								19.3	29.8
9	25.0	16.7				2.2	2.1	0.9			15.4	15.2
6		16.7	22.8	22.4	10.4	12.1	7.5	11.4	5.9	10.5	15.4	9.0
3	6.3	33.3	40.0	44.9	49.6	40.6	29.0	38.1	50.0	52.3	26.9	3.8
2	12.5	5.5	22.9	24.5	22.6	26.3	32.2	34.2	15.4	25.6	7.6	
1			11.4	8.2	17.4	18.7	29.0	15.2	28.6	11.6	3.8	

perches for an hour or more. Most new perches (82%) were within three m of previous ones. Times of peak movement occurred during early morning and late afternoon (Figs. 5, 6). Movement to new perches at these times was correlated with foraging activities. Thus movement in early morning was primarily related to the population dispersing to an enlarged sunlit area with new exposed perches. Dispersion decreased significantly after observation sites became fully sunlit, and foraging flights subsequently increased. In late afternoon sunlit areas were becoming smaller in size and fewer in number with time, and flies moved frequently as perches became shaded. Also adults moved into surrounding vegetation when sites became dark, thus accounting for increased movement at the end of the diurnal period. In early afternoon *C. albipilosa* also showed a slight increase in frequency of movement to new perches. This period and movement corresponded to the merging of two major activity patterns, i.e. while males began to search for females to court and to mate, many females continued to feed and forage. Interactions resulting between courting males and non-receptive females initially stimulated movement to new perches.

Cerotainia albipilosa foraged throughout the diurnal activity period, although the frequency and percent of flights varied significantly. Peak foraging activities by females occurred between 10:00 AM and 7:00 PM with a mean of one flight per 2.4 min (Table 2). Females were also engaged in other activities during this period, although most flights ($\bar{x}$ 76%, R_{57-90}) were associated with foraging and feeding activities. In afternoon foraging flights decreased correspondingly as other flights and behaviors increased (Fig. 5). Peak foraging times of males occurred between 10:00 AM and 1:30 PM and 5:00 and 7:00 PM, with mean foraging flights of 78 (R_{26-89}) and 51% (R_{23-53}), respectively (Fig. 6). Males foraged one time per 2.4 and 5.7 min during the first and second peaks, respectively. Foraging

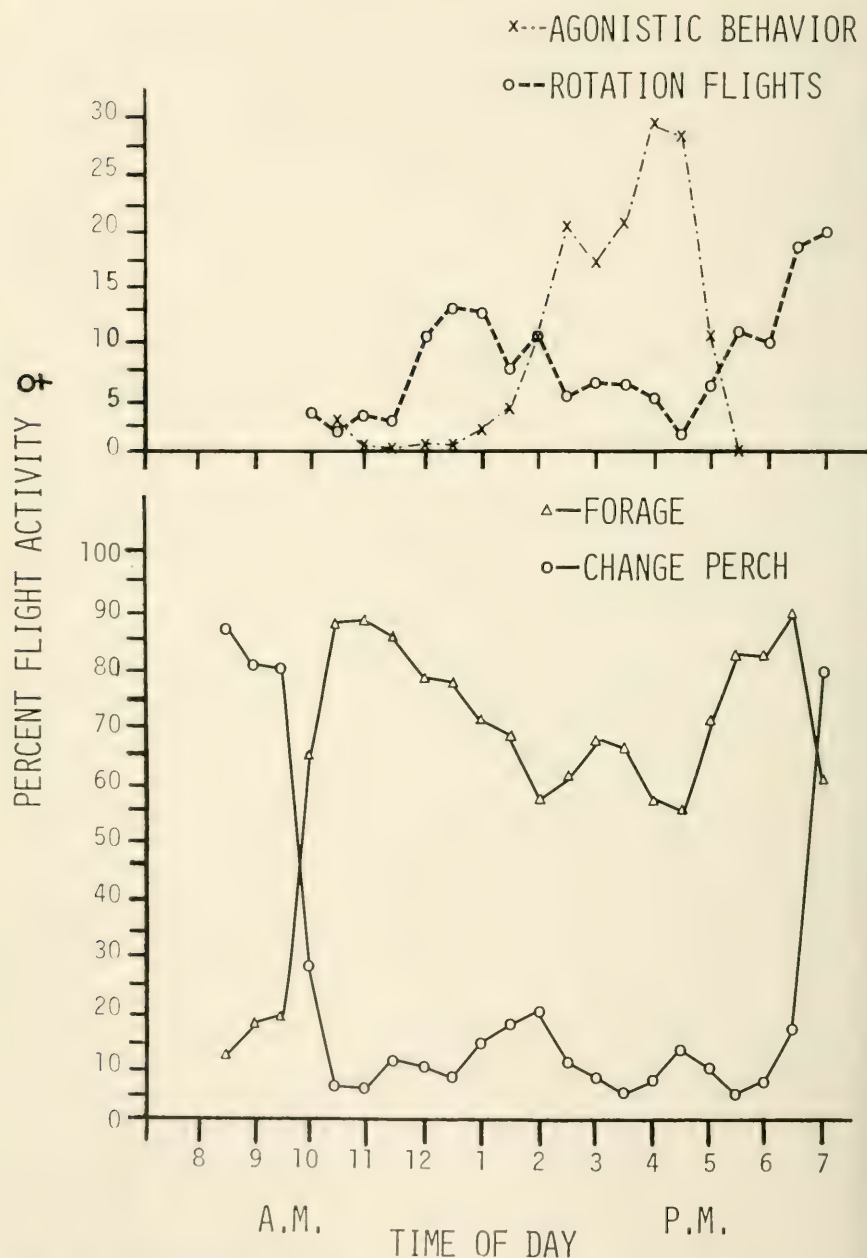


Fig. 5. Percent flight activity during the diurnal activity period of female *Cerotainia albipilosa* at the Loch Raven Watershed in Baltimore County, MD.

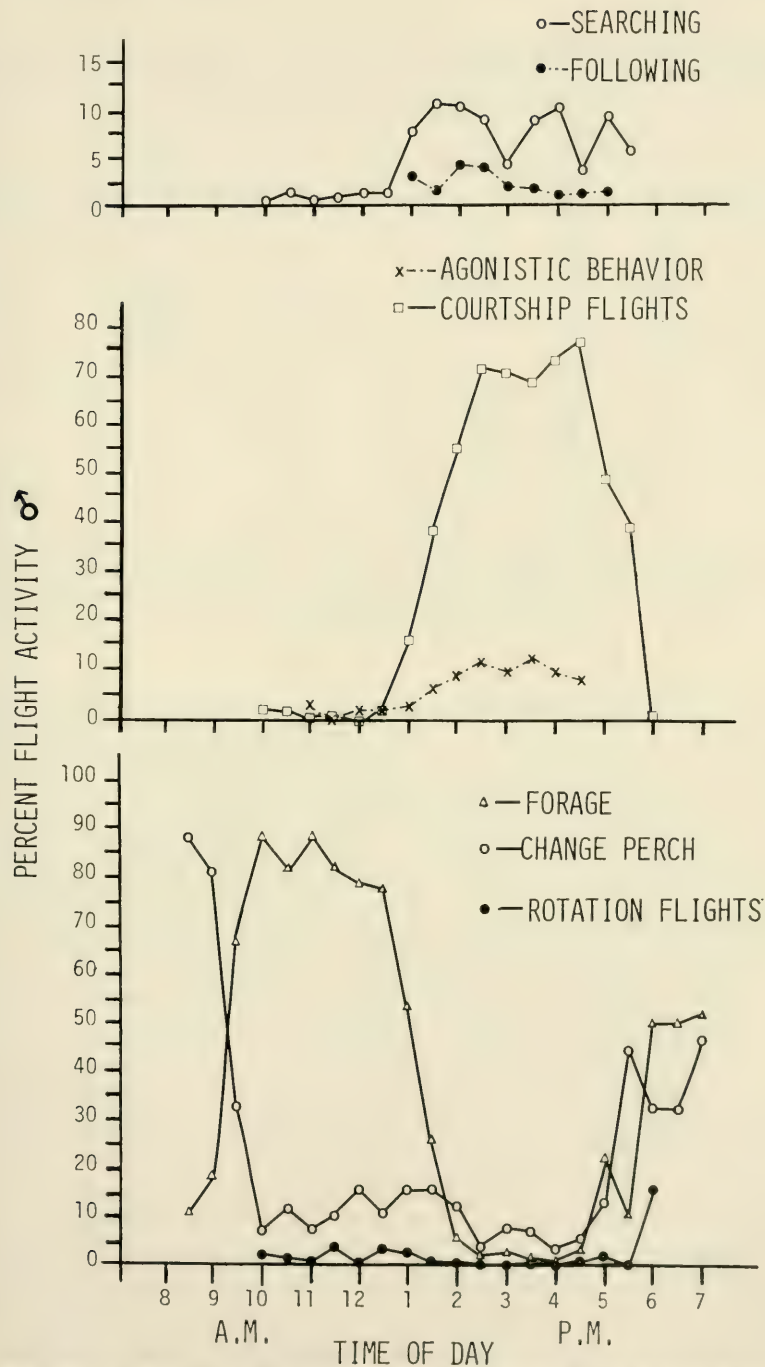


Fig. 6. Percent flight activity during the diurnal activity period of male *Cerotainia albipilosa* at the Loch Raven Watershed in Baltimore County, MD.

Table 2. Mean time intervals between major diurnal flight activities by females of *Cerotainia albipilosa* at the Loch Raven Watershed during the summer of 1975.*

Time	Minutes between flights				
	Change perch	Forage flights	Rotation flights	Agonistic flights	All flights
8 AM	6.0	11.0	0.0	0.0	5.4
9	5.0	11.3	15.0	0.0	3.5
10	5.6	2.8	15.0	15.0	2.3
11	22.0	2.3	8.2	90.0	2.0
12 PM	16.0	2.3	7.8	125.0	1.6
1	11.2	2.8	20.2	52.1	1.9
2	9.9	2.6	20.6	9.1	1.5
3	17.6	1.9	19.8	6.5	1.3
4	11.8	2.5	42.8	4.7	1.3
5	21.7	2.3	20.2	31.0	1.8
6	37.5	3.0	3.4	0.0	3.0
7	9.4	5.0	0.0	0.0	2.7

* Data based upon 10 observation hours of 10 or more individuals at each time interval. The number of flights of a single type was divided into the total observation times; 600 minutes $\div$ 40 flights = 15, thus 1 flight/15 minutes.

rates between 2:00 and 5:00 PM averaged one flight per 30 min interval (Table 3). The mean percent of individuals feeding during peak foraging times was also higher than at other times of the day (Figs. 1, 2). This was expected since foraging is directly related to feeding.

Rotation flights refer to activities in which *C. albipilosa* flew from perch sites and hovered in midair about 10–15 cm before perches while manipulating prey. Duration of flights ranged from 5–12 sec. Rotation flights by both sexes occurred throughout the feeding period, although female flights were more frequent than males (Tables 2, 3). This in part was related to prey selection and the times of foraging activities. Females frequently captured larger prey (>2.0 mm) with hard exoskeletons than did males. Larger prey, such as reproductive ants (*Lasius* sp., *Ponera pennsylvanica* Buckley), beetles (*Gymnetron* sp.) and cicadellids (*Macrosteles* spp.) with hard exoskeletons were rotated 3–8 times during feeding. Large soft bodied prey such as aphids (*Macrosiphon* spp.) and reproductive termites (*Reticulitermes flavipes* L.) were rotated less frequently (Scarbrough, in prep.). Smaller soft bodied prey such as white flies (*Aleurochiton* sp.), thrips (*Acolothrips vittipennis* Hood) and cecidomyiid flies (*Anarete* sp.) were usually not rotated. This study showed that males foraged less in afternoons than females. Furthermore Scarbrough (in prep.) showed that males captured smaller prey than females and, thereby reduced the probability of occurrence of rotation flights. Thus reduced feedings and

Table 3. Mean time intervals between major diurnal flight activities by males of *Cerotainia albipilosa* at the Loch Raven Watershed during the summer of 1975.*

Time	Minutes between flights						All flights
	Change perch	Forage flights	Searching flights	Courtship flights	Agonistic flights	Misc. flights	
8 AM	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	5.0	6.5	0.0	0.0	0.0	0.0	2.8
10	10.0	1.2	120.0	0.0	0.0	60.0	1.1
11	19.5	2.1	215.0	32.0	215.0	86.0	1.8
12 PM	13.1	2.4	115.0	20.0	115.0	92.0	1.8
1	8.6	3.9	14.1	5.7	29.0	42.2	1.4
2	9.3	21.5	7.2	1.0	6.9	16.5	0.6
3	11.1	36.2	13.2	1.2	8.2	36.2	0.8
4	16.9	50.5	11.1	1.2	10.6	51.9	0.9
5	11.5	11.4	27.9	5.1	0.0	97.5	2.4
6	12.5	8.3	0.0	0.0	0.0	250.0	3.3
7	3.6	3.1	0.0	0.0	0.0	0.0	1.7

* Data based upon 10 observation hours of 10 or more individuals at each time interval. The number of flights of a single type was divided into the total observation times; 600 minutes $\div$ 40 flights = 15, thus 1 flight/15 minutes.

subsequent rotation flights by males were directly related to a change in emphasis of activity patterns in afternoons.

The onset of reproductive activities was indicated by males searching for females to court (Fig. 6). Searching flights were readily recognized from other flight activities. Males were often difficult to approach, easily disturbed, and could not be followed for long periods unless females were encountered. They utilized several perches for short periods and flew more frequently than when involved in other flight activities. Searching flights were observed as early as 10:00 AM but most occurred between 1:00 and 5:00 PM, with averages of one flight per 11.4 min (Table 3). Searching males frequently hovered before a shaded unoccupied or occupied twig or leaf tip. If the occupant was a male, it invariably rushed the intruding male and usually drove him away. If the occupant was a female, courtship flights were initiated by the male. Searching flights were sometimes replaced by foraging and feeding activities during this period.

Males began courtship flights about one hour after observation sites became fully sunlit (10:00 AM) and continued until late afternoon (5:30 PM) (Fig. 6). Most flights, however, occurred between 2:00 and 5:00 PM, with mean frequencies of about one flight per min (Table 3). Temperature and relative humidity during courtship and mating periods averaged 32°C and 57%, respectively (Fig. 4). Courtship flights were launched from perches ranging from 1–6 cm behind perched females and averaged

6 sec (R3-11) in total flight time. Courting males remained with a single female for about 23 min although times were often much longer (>60 min). The length of this time interval was influenced by agonistic interactions of courted females and intruding males. These interactions were especially frequent during peak courtship periods at which time several males (1-4) attempted to court a single female. Under these conditions, non-receptive females flew after courting males and drove them away (Table 2; Fig. 5). At other times females flew from the area, in which case males occasionally followed. Searching males were frequently attacked by resident courting males, resulting in an aerial combat and one male leaving the area (Table 3; Fig. 6). During these male-male interactions, females foraged or were courted by still other males. Thus most courtship interactions between males and females did not result in copulations (Scarborough, in prep.). Similar agonistic interactions among other species of asilids have been reported (Lavigne and Holland, 1969; Dennis and Lavigne, 1975).

In any population of animals, certain activities occur at a particular time of day. As the frequency of occurrence of a certain activity increases, the probability that other activities will occur usually decreases (Dennis and Lavigne, 1976). Several species of asilids have been shown to exhibit periodicity of diurnal activities (Dennis and Lavigne, 1975; Lavigne and Dennis, 1975; Scarborough and Sipes, 1973; Scarborough, 1974; Rogers and Lavigne, 1972; Musso, 1971, 1972). It is interesting to note that both sexes of *C. albipilosa* foraged and fed during most of the day although males performed these activities almost exclusively during two distinct periods. However, times of peak foraging flights by females corresponded to those of males (Figs. 5, 6). The similarity in foraging activities was directly related to the role of the male in reproductive activities. In early afternoon males showed a marked decrease in feeding and foraging activities, and began courtship flights which subsequently resulted in matings (Figs. 2, 3). Consequently, females showed a decrease in foraging activity during this period. In late afternoon courtship and mating activities ceased and were followed by renewed foraging and feeding activities. Furthermore, *C. albipilosa* does not feed at night and, presumably, needs a minimal food reserve for this inactive period (about 12-13 h). The brief feeding period following courtship flights and matings in late afternoons undoubtedly contributes to this energy need. Thus *C. albipilosa* have apparently partitioned feeding times to accommodate energy needs for reproductive activities and nocturnal inactivity. Musso (1971) reported a similar feeding-mating periodicity by *Andrenosoma hayardi* (Seguy).

Various environmental parameters have been reported to influence flight activity of asilids (Lavigne and Dennis, 1975; Musso, 1971, 1972; Zinovera,

1959). In addition to temperature as previously mentioned, light and wind affected the daily flight activity of *C. albipilosa*. During periods of poor light conditions, such as overcast skies, flight activity was greatly reduced and seldom occurred if conditions persisted for extensive times. Presumably the asilids' ability to detect moving objects (prey) or perched females was affected during these poor lighting conditions. Furthermore potential prey presumably responded similarly to reduced light conditions and, subsequently, were not abundant and available (flying) as a food source to the predator. Most flights during overcast days were conducted from perches in the brightest areas of the observation sites. These perches were usually at/or near tops of trees. Activities such as feeding and mating previously initiated under more optimal conditions continued during overcast periods but took longer than under sunlit conditions. When wind gusts exceeded 20 km per hour, *C. albipilosa* did not fly as often as when the wind was not blowing. Adults usually remained perched when gusts exceeded these speeds, although a few were blown and/or flew into surrounding vegetation. Courtship flights and matings did not occur at these wind speeds.

Seasonal distribution and abundance.—Seasonal distribution of *C. albipilosa* from 1972–1974 at the Loch Raven Watershed is shown in Fig. 7. *Cerotainia albipilosa* was present in the field during most of the summer with the population appearing in early July and continuing until early September. The seasonal pattern, however, may be slightly altered by unseasonable climatic conditions. The 1972 population first appeared and remained in the field about seven to ten days later than those in 1973 and 1974. The shift in seasonal pattern was apparently influenced by an unusually heavy rainfall resulting from a tropical storm (Hurricane Agnes; U.S. Climatological Data, 1972). Also, recent collecting records showed that the pattern may be moved to an earlier emergence when spring temperatures are unseasonably warm. In 1975 adults were in the field by 24 June, following unusually high temperatures in spring (U.S. Climatological Data, 1975).

As in the case of numerous asilid species, *C. albipilosa* became abundant during the early part of the season and decreased gradually as the season progressed (Fig. 7). However two periods of peak abundance (about mid-July and early August) were apparent each year. The first population peak was represented primarily by the fly population in large, dry clearings near the tops of hills. Flies were usually absent at these sites by early August. The second peak was represented by segments of the population in clearings adjacent to a stream and march in the lowland woods in early August. Flies were scarce at these sites until late July. The significance of these two population peaks is uncertain at this time.

This study also showed a steady rise each year in the asilid population

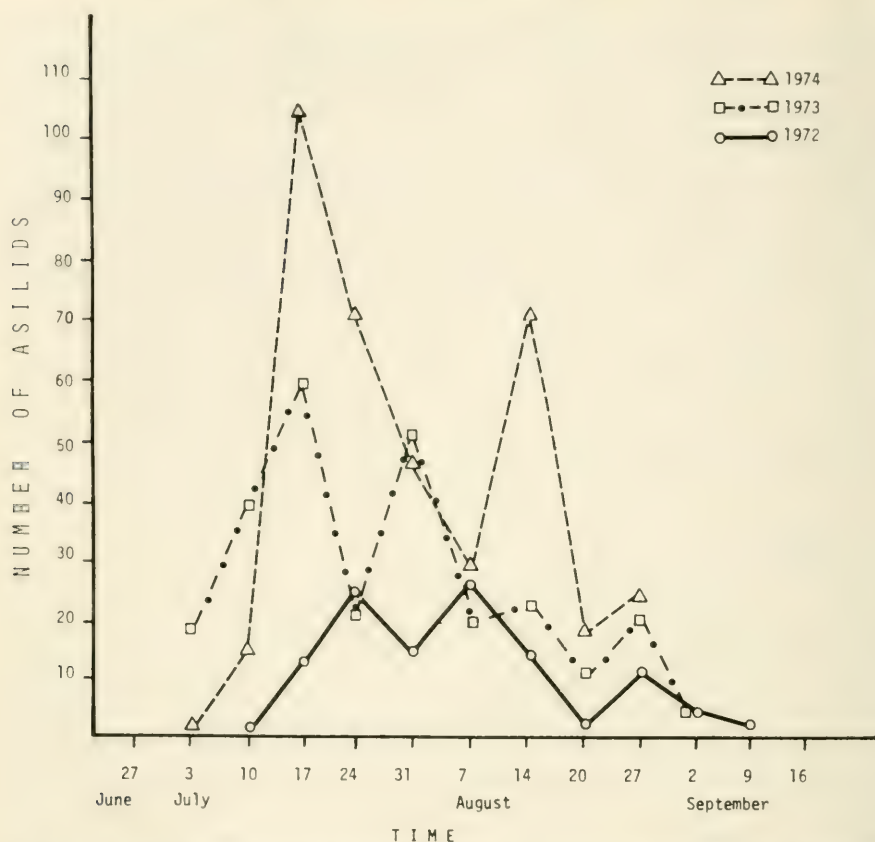


Fig. 7. Seasonal distribution and abundance of *Cerotainia albipilosa* at the Loch Raven Watershed in Baltimore County, MD.

(Fig. 7). The change may represent an increase in sampling efficiency. However, since the identical technique of sampling was followed each year and since adults were extremely easy to catch with net or vial, this would not appear to be the major reason. While the abundance of the fly was unknown before this study, the increase during the study was probably a real one. An increase in population density in the study sites was undoubtedly influenced by an unusually high accumulated rainfall during the month of June 1972 and changes in the structure of the paths. Accumulated rainfall during June 1972 was 11.19 in, and 4.07 and 4.25 during June 1973 and 1974, respectively (U.S. Climatological Data, 1972, 1973, 1974). The unusually moist period during 1972 probably eliminated a significant proportion of the soil population, which was in the late larval in-

stars or pupal stage at this time. Also, removal of felled trees and brush following the unusually wet period in 1972 produced new sunlit openings and mowed margins of paths widened existing ones. The above provided additional activity perches for flies, thus dispersing the population to new and larger sites in the woods. Furthermore, this would reduce competition and permit possible expansion of the population during 1973 and 1974.

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Footnotes

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A NEW SPECIES OF *CARISTANIUS* FROM FLORIDA
(LEPIDOPTERA: PYRALIDAE: PHYCITINAE)^{1, 2}

H. H. Neunzig

Abstract.—*Caristanius minimus*, new species, is described from the Florida Keys. The larval host is *Cassia keyensis* (Pennell) MacBride.

During a study of the immature phycitines associated with leguminous plants in the southern United States, an undescribed species of *Caristanius* was collected. This paper provides a name so that information on the immature stages and biology of this species can be included, along with similar information on other legume-feeding phycitines, in a subsequent publication.

Caristanius minimus Neunzig, new species
(Figs. 1-6)

Wing expanse.—16-19 mm.

Head.—Male: Brown to purplish brown, dusted with white; labial palpi purplish brown and/or fuscous dusted with white. Female: Fuscous to purple, dusted with white; labial palpi mostly fuscous dusted with white.

Thorax.—Male: Collar and dorsum brown or purplish brown. Female: Both collar and dorsum somewhat darker, at times, with scattered fuscous or black scales.

Primaries.—Male: Brown, or purplish brown, moderately to heavily dusted with white (white particularly strong in median area); antemedian line indistinct, or absent, anteriorly, becoming distinct and broad in posterior half of primary; preceding antemedial line a black patch on inner margin extending to or into cell (patch occasionally with some purplish brown scales); subterminal line sinuate; usually relatively distinct; discal spots usually relatively distinct, close together, but separate, sometimes slightly fused; a row of black dots along termen. Female: Usually with darker (fuscous) ground color (sometimes partially overlaid with purple); less white dusting, and discal dots obscure.

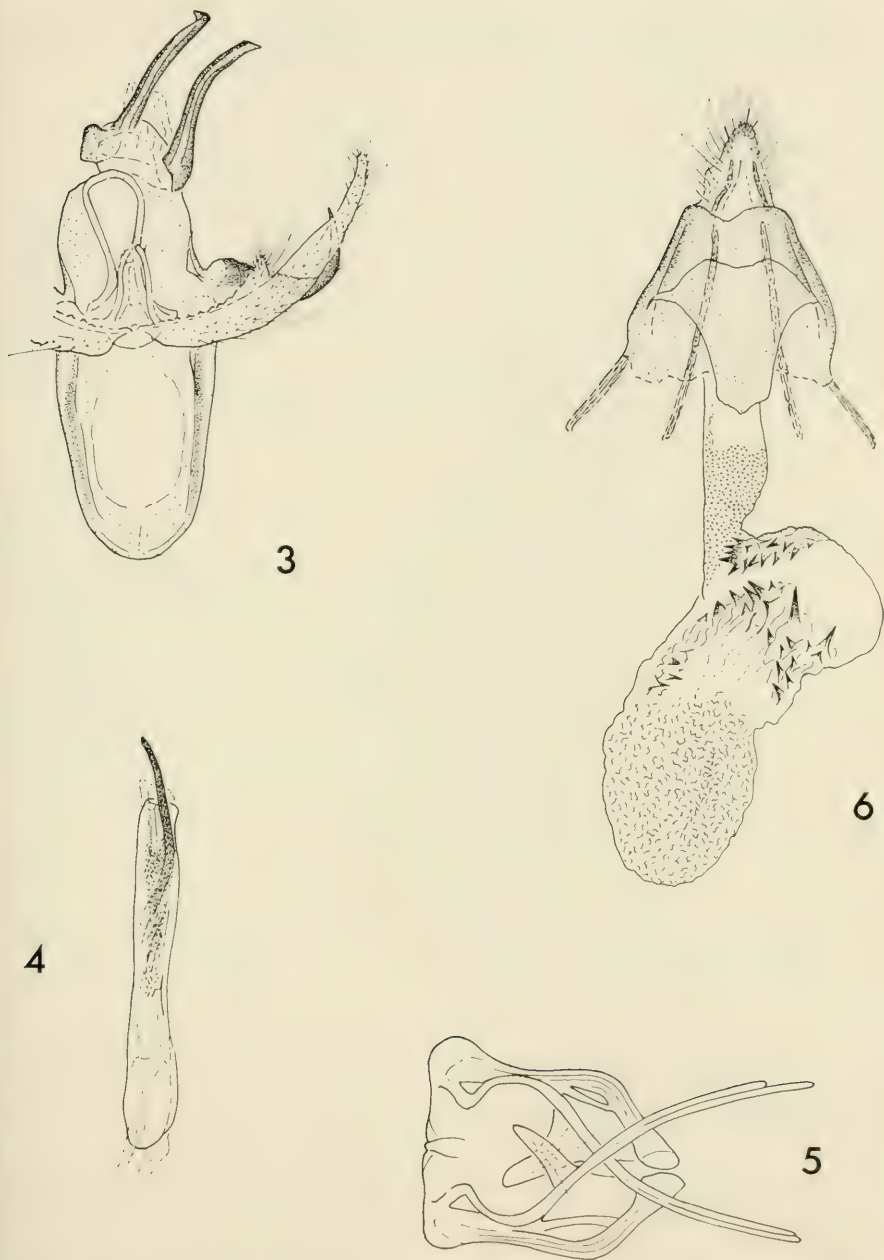
Secondaries.—Male: Translucent, whitish with brown extending onto wing from costal margin, and a narrow brown line along termen. Female: Dark shading of wing more extensive.

Genitalia.—Male: Uncus with posterior margin convex, and with distal extremities of arms strongly angulate; costa of valve broadly and strongly sclerotized, produced into a relatively large inwardly and evenly curved, apically pointed process; sacculus short, bluntly produced at apex; cucul-



Figs. 1, 2. *Caristanius minimus*. 1, male (holotype). 2, female.

lus elongate, weak; anellus with 2 elongate lobes with slender extremities; aedeagus elongate, armed with a single cornutus and numerous very small spines and granulations (cornutus about $\frac{1}{2}$ as long as aedeagus); vinculum longer than greatest width. Female: Granulations of ductus bursae extending for a very short distance into corpus bursae; signa present in posterior half of corpus bursae, strongly developed into a series of heavily sclerotized, fused plates possessing inwardly directed spines; anterior half of corpus bursae granulate; eighth-segment collar incomplete ventrally, strongly sclerotized dorsally.



Figs. 3-6. *Caristanius minimus*. 3 and 4, male genitalia (holotype). 5, male tufts of 8th abdominal segment (holotype). 6, female genitalia.

Holotype.—Big Pine Key, Florida, ♂, reared from larva collected 9-V-73, *Cassia keyensis*, Coll. H. H. Neunzig. USNM Type No. 73783, ♂ genitalia slide 359; in the National Museum of Natural History (USNM).

Paratypes.—FLORIDA: Big Pine Key, 1♀, reared from larva collected 9-V-73, *Cassia keyensis*, Coll. H. H. N.; 13♂, 1♀, 9-V-73, light trap, Coll. H.H.N.; 2♂, 1♀, 10-V-73, light trap, Coll. H.H.N.; 1♂, 5-IX-74, light trap, Coll. H.H.N.; 2♀ reared from larvae collected 6-IX-74, *Cassia keyensis*, Coll. H.H.N.

The three paratypes collected at a light trap 10-V-73, and the two paratypes reared from larvae collected 6-IX-74 have been placed in the National Museum of Natural History (USNM). The remaining paratypes are in the North Carolina State University Museum.

Larval host.—*Cassia keyensis* (Pennell) Macbride.

Distribution.—Known only from Big Pine Key, Florida.

Discussion.—*Caristanius minimus* differs from other species of *Caristanius*, described in Heinrich (1956), in being smaller. *Caristanius minimus* has an average wing expanse of only 17 mm, whereas, other species in the genus average about 22 mm.

The maculation of *C. minimus* is similar to *Caristanius decoloralis* (Walker) but the former species usually has a darker patch of scales preceding the antemedial line on the inner margin of the wing.

On the basis of genitalia, *C. minimus* appears to be closely allied to *Caristanius pellucidellus* (Ragonot). There are, however, differences in the male genitalia of the two species, particularly in the appearance of the costa of the valve. This part of the valve is produced into an evenly curved, apically pointed process in *C. minimus*, in contrast to an apically rounded, folded and contorted costa in *C. pellucidellus*.

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Footnotes

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DISPERSAL OF THE INTRODUCED PALAEARCTIC SAWFLY,
HALIDAMIA AFFINIS (FALLÉN), IN NORTH AMERICA
(HYMENOPTERA: TENTHREDINIDAE)¹

Harold N. Greenbaum²

Abstract.—The Palearctic sawfly, *Halidamia affinis* (Fallén), was introduced into North America prior to the first record from Long Island, New York in 1931. Subsequent records within the next three years from surrounding states, and later from Michigan, Wisconsin and Maryland, suggest a slow inland dispersal of *H. affinis*, or transport across the Appalachian Mountains or down the St. Lawrence River by man. Specimens collected in eastern Kansas and west-central Missouri in 1976 indicate that *H. affinis* is apparently dispersing over much of eastern North America.

Halidamia affinis (Fallén) (Hymenoptera: Tenthredinidae: Blennocampinae) is the only known species of *Halidamia* Benson, a Palearctic genus belonging to the primarily Neotropical tribe Waldheimiini (Smith, 1969). *Halidamia affinis* is cosmopolitan in Europe (Benson, 1952) but was not collected in North America until 1931 (Smith, 1969). Ross (1951) stated that the species was introduced into New York. The first known adult collection record is Cold Spring Harbor, Long Island, New York, 4-V-1931, as given by Smith (1969). Smith mentioned that it was introduced into North America but did not discuss its dispersal.

Smith (1969) listed the records of *H. affinis* known to him at that time, among which were the following first state collection records: NEW YORK: as above; CONNECTICUT: N. Bradford, 12-V-1933, M. P. Zappe; NEW JERSEY: Haddon Heights, 29-V-1934, L. J. Bottimer; MICHIGAN: E. Lansing, 15-V-1957, R. L. Fischer; ONTARIO: Point Pelee, 4-5-VI-1961, Kelton and Brumpton; MARYLAND: Upper Marlboro, 20-IV-1963, W. R. M. Mason; and WISCONSIN: Racine Co., Rochester, and Jefferson Co., Jefferson, both 7-VI-1966, M. S. Conrad. Smith's record for Michigan is preceded by a female in the Snow Entomological Museum (University of Kansas, Lawrence) with the following data: Washtenaw Co., Saginaw Forest, 25-V-1950, E. B. Hayden. The first inland collection records occurred about 20 years following the initial date of collection. The subsequent records given by Smith (1969) are primarily concentrated into 2 areas: (a) on the Atlantic coastal plain and Long Island; and (b) in the southern Great Lakes area, primarily in Michigan. Two new records for *H. affinis* are: KANSAS: Douglas Co., Lawrence, 15-IV-1976, C. D. Michener (1 female), and MISSOURI: Jackson Co., Kansas City, 2-V-1976, H. Greenbaum (1 female) (both specimens in the personal collection of the author).

Should these records be indicative of the dispersal of *H. affinis*, then the following conclusions may be drawn:

(1) Following initial introduction into Long Island, New York, *H. affinis* dispersed within a few years to the subcoastal areas of New York and the surrounding states (New Jersey and Connecticut) where it became established.

(2) Inland dispersal of *H. affinis* occurred either by a slow migration, or transport down the St. Lawrence River via commercial shipping (Smith, personal correspondence) or across the Appalachian Mountains by man.

(3) Westward dispersal of *H. affinis* around the Great Lakes is indicated by Smith's (1969) Wisconsin records.

(4) *Halidamia affinis* has dispersed southward from the southern Great Lakes area as indicated by the Kansas and Missouri records.

Apparently this species is gradually dispersing over much of eastern North America. *Halidamia affinis* is now known to occur in North America from Connecticut south to Maryland and west to Wisconsin (Smith, 1969), and eastern Kansas.

Acknowledgments

I extend my appreciation to Dr. Charles D. Michener (Department of Entomology, University of Kansas, Lawrence) for the specimen from Kansas. I also thank Dr. George W. Byers (same) for giving me the opportunity to examine sawflies in the collection of the Snow Entomological Museum. I also extend my sincere appreciation to Dr. David R. Smith (Systematic Entomology Laboratory, Agric. Res. Serv. USDA) and to my colleagues at the University of Arkansas for their advice and suggestions.

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Footnotes

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CRYPTADIUS ANDREWSI, A NEW SPECIES OF
TENEBRIONIDAE (COLEOPTERA) FROM SONORA

Richard Lee Berry

Abstract.—*Cryptadius andrewsi*, new species, is described from Cholla Bay, Sonora, Mexico. This is the second species of *Cryptadius* known to occur in Sonora.

In 1974, I described *Cryptadius sonorae* Berry, the first species of *Cryptadius* known to occur in Sonora, Mexico (Berry, 1974). A second species from Sonora has recently come to my attention and is described in the following account.

Cryptadius andrewsi Berry, new species

Male (holotype).—Moderately shining, nigro-piceous above, dark rufo-piceous beneath, oval, dorsum convex. Length 7.1 mm; width 3.4 mm.

Head with genae entering eyes to about $\frac{1}{4}$ eye width; punctures large, dense, perforate on fronto-vertex, tending to fuse laterally into a concentric pattern. Clypeus and genae subequally produced anteriorly (Fig. 2). Pronotum (Fig. 1) with sides convex; front edge broadly concave; front angles abruptly rounded, slightly produced anteriorly; base broadly convex, slightly bisinuate submesally; basal angles obtuse, abrupt; base subequal in width to base of elytra; punctures large, dense, round and deep in middle $\frac{1}{4}$, becoming dense, oblique, and confluent laterally and forming longitudinal rugulae between confluent punctures. Pronotum with sparse, moderately long, erect setae on lateral edge; with sparse, short setae near lateral edge, and longer setae directly behind eyes, reaching to eyes (when head in repose); with marginal bead complete across middle of front edge. Prosternum with large, dense, lunato-granulate punctures. Ventral pronotum punctato-granulate, lunate granules fused into longitudinal rugulae; sparsely clothed with short setae. Elytra with sides convex; with punctures distinct, dense, small, associated with small raised granules, shallower in lateral $\frac{1}{4}$ and apical $\frac{1}{2}$; granules with distinct linear arrangement in apical $\frac{1}{2}$; with sparse, short, erect setae laterally and apically. Scutellum broad, shallowly entering elytra. Epipleuron with a row of moderately long, golden-colored setae along outer edge and with sparse, short setae mesally; moderately densely granulate mesally. Mesosternum with posterior process just touching anterior margin of metasternum; with dense, large punctures. Metasternal punctures large, moderately dense, and shallow. Abdominal sterna moderately densely punctate at middle of sterna 1-3, punctures larger, denser, and deeper laterally and on sterna 4 and 5. Tegmen with

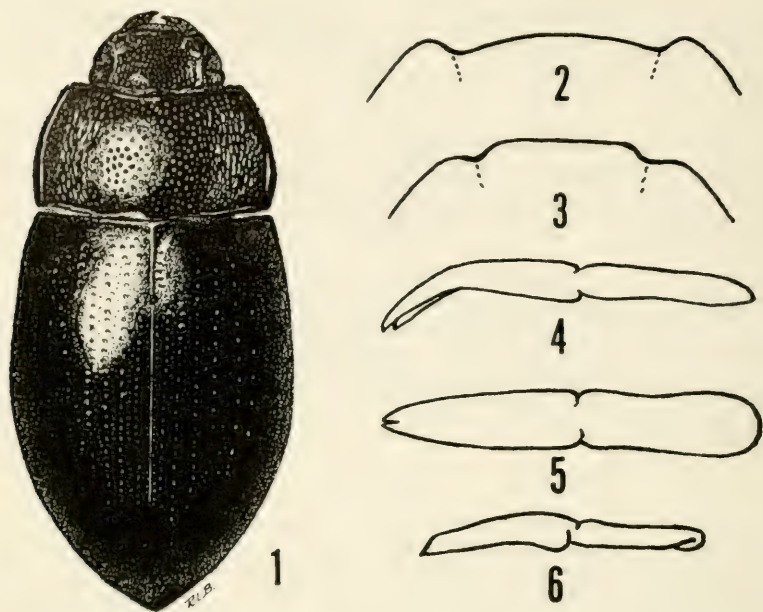


Fig. 1. *Cryptadius andrewsi*, dorsal view of head, pronotum, and elytra. Figs. 2-3. Dorsal outline of anterior edge of clypeus and genae. 2, *C. andrewsi*, clypeus not prominent. 3, *C. sonora*, clypeus prominent. Figs. 4-5. *Cryptadius andrewsi*, tegmen. 4, lateral view. 5, ventral view. Fig. 6. *Cryptadius sonora*, tegmen, lateral view.

apicale narrow, slightly dorsoventrally flattened, acute, and narrowly, deeply notched at apex; distinctly curved ventrad in apical $\frac{1}{2}$ (Figs. 4-5).

Allotype female.—Agrees with male holotype in morphological details except in size and genitalia. Length 7.4 mm; width 3.9 mm.

Measurements.—Females, length 6.3-8.6 mm, average (of 13) 7.2 mm; width 3.2-4.1 mm, average (of 13) 3.6 mm. Males, length 5.6-7.5 mm, average (of 18) 6.8 mm; width 2.7-3.8 mm, average (of 18) 3.4 mm. Thirty others, of undetermined sex, were not measured.

Holotype ♂.—Mexico: Sonora, Cholla Bay, 20-III-1973, ex beach dunes, Fred G. Andrews, A. R. Hardy. USNM¹ Type No. 73773.

Allotype ♀, paratypes 4♂, 3♀, 3 sex unknown (USNM); 4♂, 3♀ (CASC); 4♂, 2♀ (OSUC); 3♂, 2♀, 27 sex unknown (FGAC); 3♂, 2♀ (RLBC). All with same data as holotype.

Dr. Andrews informed me that all of the specimens were collected from under a single plant growing at the extreme tip of a long sand dune that narrowed and extended out into a sand spit.

The species is named for Dr. Fred G. Andrews, who collected the specimens.

Discussion

Cryptadius andrewsi seems to be closely related to *C. sonorae*, from which it may be distinguished by the following characters. *Cryptadius andrewsi* has the base of the pronotum subequal to or slightly wider than the base of the elytra (Fig. 1), the granules of the elytra are arranged in linear series in the apical $\frac{1}{2}$ (Fig. 1), the pronotal marginal bead is complete across the anterior edge, the clypeus and genae are subequally produced anteriorly (Fig. 2), and the apicale is distinctly convex when viewed in lateral aspect, curving ventrad in the apical $\frac{1}{2}$ (Fig. 4). *Cryptadius sonorae* has the base of the pronotum slightly narrower than the base of the elytra, the granules of the elytra are arranged in a random order, the pronotal marginal bead is incomplete at the middle of the anterior edge, the clypeus extends farther anteriorly than the genae (Fig. 3), and the apicale is horizontal or only slightly curved ventrad when viewed in lateral aspect (Fig. 6). *Cryptadius andrewsi* may also be confused with *C. angulatus* Blaisdell, but the latter has a rufo-piceous coloration above, elytral punctures not distinct, and a dull or alutaceous surface lustre, whereas *C. andrewsi* has a nigro-piceous coloration above, elytral punctures distinct and associated with granules, and the surface lustre is moderately shining.

Acknowledgments

I would like to thank Dr. David H. Kavanaugh of the California Academy of Sciences for allowing me to borrow paratypes of *C. sonorae* for comparative studies.

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Footnote

¹ Abbreviations for depositories are those established by Arnett and Samuelson (1969).

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TABANIDAE (DIPTERA) OF TEXAS. VII.
COMPARISONS OF UPLAND AND LOWLAND TABANID
POPULATIONS IN SOUTHEAST TEXAS

Patrick H. Thompson

Abstract.—The tabanid faunas of adjacent upland and lowland ecosystems on the Navasota River of south-central Texas produced 17,370 and 12,540 flies, respectively, through daily collections at each site with one Gressitt Trap using carbon dioxide. These catches included 26 species at each locality; 21 species were common to both localities. However, based upon collection data from four previous years, the lowland fauna was probably more diverse and produced eight more resident species and more of the numerous species in greater numbers. At the upland and lowland locales, the genus *Tabanus* included 65 and 73% of the species, respectively, and 96 and 92% of the specimens. *Tabanus s. subsimilis* Bellardi and *T. sulcifrons* Macquart were among the three most abundant dominants at each community, whereas four spp. were found in large numbers in one community but nearly absent in the other (many *Tabanus quaesitus* Stone, uplands; *T. fuscicostatus* Hine, *T. lineola* L. and *Hybomitra lasiophthalma* (Macquart), lowlands). The upland ecosystem produced 26% more material than the lowland one, probably because August–September floods drowned large numbers of pupae of *T. s. subsimilis* and of other species.

The post-oak belt of south-central Texas is comprised of oak forests and savannahs (85%) and bottomlands (15%). The Tabanidae of this region were first described by Thompson (1974), when the area sampled included 11 localities along the banks and the sloughs of the Navasota River; and pastures and woodlands near impoundments and intermittent streams within several miles of the river. Subsequently, two of these localities were studied intensively for four years. During the last year of the 5-year study (1975), large collections with carbon dioxide enabled the detailed descriptions and comparisons of these faunas reported here.

The Study Areas

The uplands.—The trap here was located on a ridge of a post oak forest near my home, 12 miles from the Navasota River locality. Post oaks (*Quercus stellata* Wang.) and winged elms (*Ulmus alata* Michx.) are the predominating trees here, with some blackjack oaks (*Quercus marilandica* Muenchh.) on the ridges, and water oaks (*Q. nigra* L.) and black hickories (*Carya texana* Buckl.) in the gullies and washes. The sometimes dense shrub layer is comprised of yaupon (*Ilex vomitoria* Ait.) and several lianas,

including greenbrier (*Smilax* spp.), poison ivy (*Rhus radicans* L.), and Virginia creeper (*Parthenocissus quinquefolia* (L.)). Other abundant species in the shrub understory include hawthorns (*Cretaeus* spp.) and farkleberry (*Vaccinium arboreum* Marsh.). Forbs in the heavily-shaded ground layers are sparse but become dense in sunlit openings. The subsoils are Lufkin-Edge and Lufkin-Tabor claypans covered by shallow (6-in.), slightly acid, fine sandy loams. These soils drain and retain moisture poorly. Standing waters include a shallow impoundment of several acres, small pools in the intermittent stream feeding it, and woodland pools fed by seepage from homes and by runoff.

The lowlands.—The Navasota River is a secondary stream which originates in Hill County and flows southwestward, draining most of Madison, Grimes, and Brazos counties throughout its 125-mile course, before emptying into the Brazos River near Navasota. In the study area, the floodplain forms a 2-mile-wide basin overlain with 3 natural vegetative cover types—Upland Forest, like that previously described, on the upper slopes and flats; Transition Forest on the basal slopes below; and Bottomland Forest on the floodplain proper. These forests are comprised of woody plant communities, the 9 dominant overstory species of which form a continuum, gradually replacing one another from the uplands onto the floodplain, and then to the river margin: Post oak, black hickory, winged elm, overcup oak (*Quercus lyrata* Walt.), willow oak, cedar elm (*Ulmus crassifolia* Nutt.), water elm (*Planera aquatica* Gmel.), swamp privet (*Forestiera acuminata* (Michx.) Poir.), and black willow (*Salix nigra* L.). The floodplain soils of local streams flowing to the Navasota are primarily Gowen or Ochlockonee Series; and the dark gray clays of the floodplain proper, Navasota Series.

Methods

One Gressitt Trap (Gressitt and Gressitt, 1962; modified by Thompson and Holmes, 1976) was operated continuously at each locality for the 6-month period, 23 March–22 September 1975. The trap in the uplands near my home (Mile Drive) was placed across the shallow channel of an intermittent stream feeding a nearby impoundment. This trap was serviced daily. The Gressitt Trap at the lowland locale on the river was located at the intersection of the river with Farm Road 2038 and was erected in a long, linear opening extending upland from a slough into the adjacent forest some 100 yards above it. This trap was serviced three days weekly (MWF). Dry ice was replenished at each site three days weekly.

Results

The upland fauna.—Mile Drive collections produced 17,232 females and 138 males of 26 spp. in 7 genera (Table 1). Nine of the 26 spp. were repre-

Table 1. Gressitt Trap catches from upland and lowland communities, Brazos County, 23 March–22 September 1975.

Species	Upland		Lowland	
	♀	♂	♀	♂
<i>Silvius quadricittatus</i> var. <i>texanus</i> Pechuman ^a	1			
<i>Chrysops</i>				
<i>callidus</i> Osten Sacken	282	1	96	
<i>flavidus</i> Wiedemann	47		56	
<i>montanus</i> Osten Sacken	6			
<i>pikei</i> Whitney	262	4	307	2
<i>virgulatus</i> Bellardi ^a	3			
<i>Chlorotabanus crepuscularis</i> (Beq.) ^b	2		9	
<i>Whitneyomyia beatifica</i> var. <i>atricorpus</i> Philip	2	1	2	
<i>Leucotabanus annulatus</i> (Say)	8		5	
<i>Tabanus</i>				
<i>americanus</i> Forster			7	
<i>atratus</i> F. ^b	5	1	12	2
<i>colombensis</i> Macquart ^a	1			
<i>cymatophorus</i> Osten Sacken ^b	38		106	
<i>eurycerus</i> Philip ^{a c d}	1			
<i>fuscicostatus</i> Hine ^a	7		671	15
<i>lineola</i> F. ^b	21		551	4
<i>melanocerus</i> Wiedemann ^b	71		30	
<i>molestus</i> Say ^b	13		29	1
<i>mularis</i> Stone	316	2	53	
<i>nigripes</i> Wiedemann	4		73	2
<i>petiolatus</i> Hine ^b			14	
<i>proximus</i> Walker ^b	36		1,639	9
<i>pumilus</i> Macquart			3	
<i>quaesitus</i> Stone	1,230	6	42	
<i>sparus</i> var. <i>milleri</i> Whitney			22	1
<i>sublongus</i> Stone ^c			4	
<i>s. subsimilis</i> Bellardi ^b	12,524	118	7,133	39
<i>sulcifrons</i> Macquart	1,826	5	1,055	5
<i>trimaculatus</i> Palisot de Beauvois ^b	235		254	2
<i>venustus</i> Osten Sacken ^b	5		9	
<i>Hybomitra lasiophthalma</i> (Macquart) ^a	6		560	16

^a Locality record, uplands.^b Species collected from several habitats, lowland locality (Thompson et al., 1977).^c Atypical specimens (*Tabanus* sp. near *eurycerus* Philip and *Tabanus* sp. near *sublongus* Stone, respectively).^d State record, pending confirmative determination based upon more material.

sented by more than 50 specimens (Fig. 1). The genus *Tabanus* included 65% of the species collected and 96% of the specimens. The three most abundant dominants, *T. subsimilis subsimilis* Bellardi, *T. sulcifrons* Macquart, and *T. quaesitus* Stone, included 90.5% of the material taken (Fig.

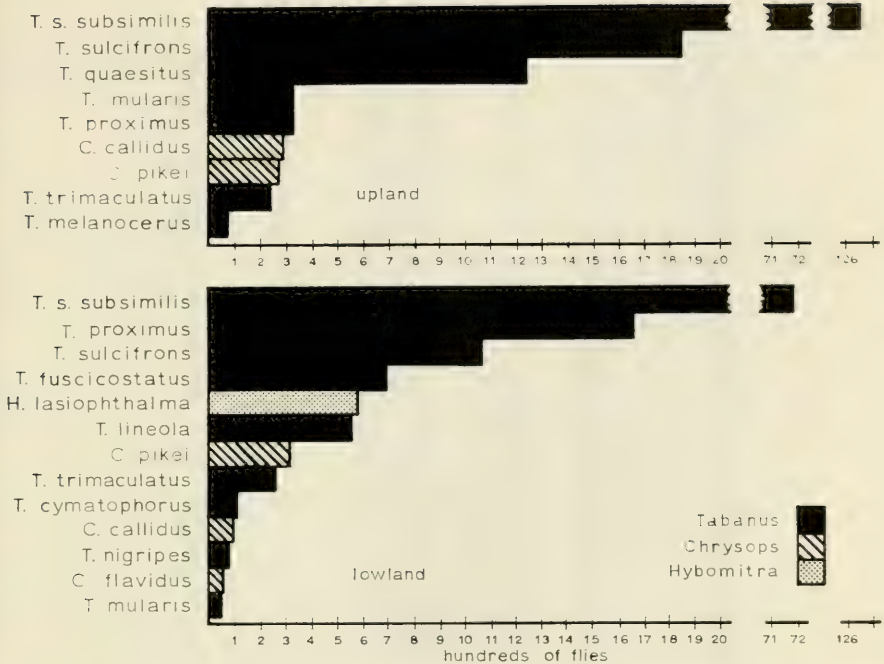


Fig. 1. Relative abundance of dominant and subdominant Tabanidae, upland and lowland locales, Brazos County, Texas, 1975.

1 and Table 2). The collections of six spp. established new locality records and a state record (Table 1).

The seasonal succession and ranges of the 26 spp. collected at the two sites are illustrated in Figs. 2 and 3. Numerical distributions for those species represented by 50 or less specimens are indicated in these figures, whereas Fig. 4 presents that information for those abundant species from both localities having distinct peaks; the distributions for some numerous forms were not illustrated in the latter figure because they occurred regularly and in small numbers throughout long seasons of appearance (e.g., as for *T. proximus* at the upland locale, Fig. 4).

The lowland fauna.—The riverine collections included 12,742 females and 98 males of 26 spp. in six genera (Table 1). Thirteen species were represented by 50 or more specimens (Fig. 1). The genus *Tabanus* included 73% of the species taken and 92% of the specimens. The three most abundant forms taken in catches were *T. s. subsimilis*, *T. proximus* Walker, and *T. sulcifrons* and included 77% of all the material taken (Fig. 1 and Table 2).

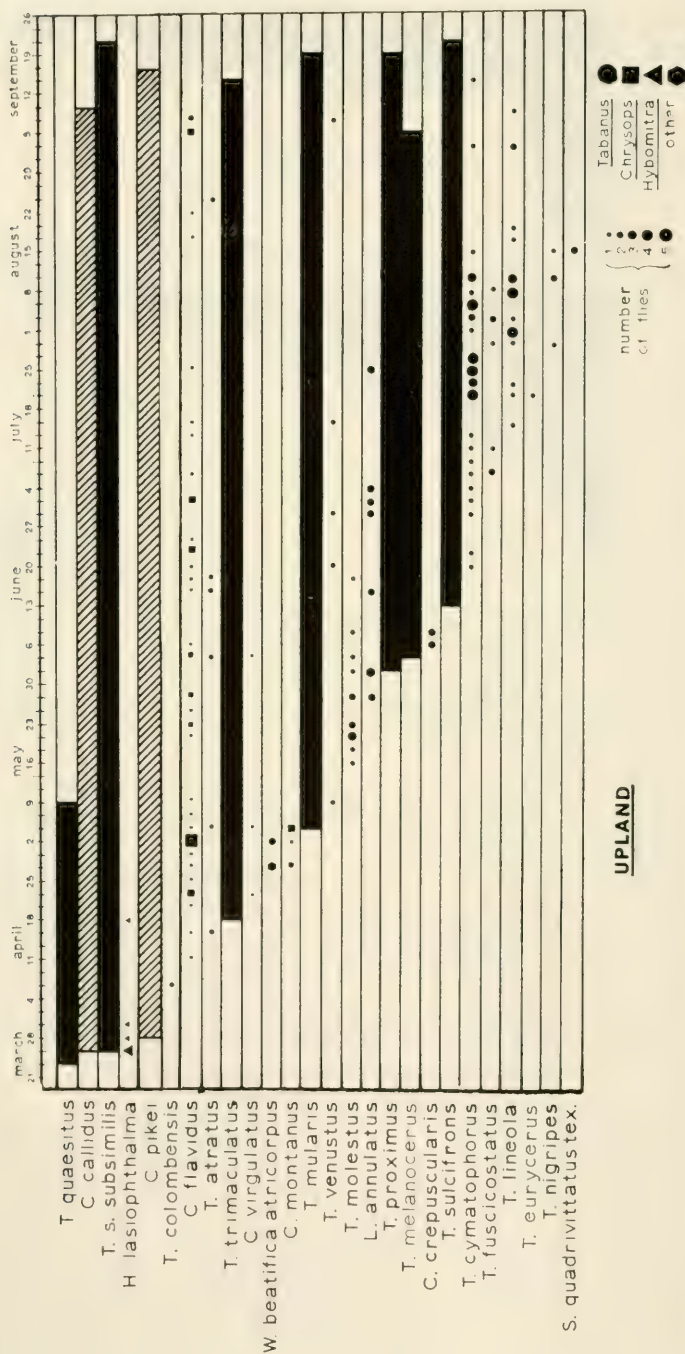


Fig. 2. Seasonal succession and range of 26 species of Tabanidae, upland locale, Brazos County, Texas, 1975.

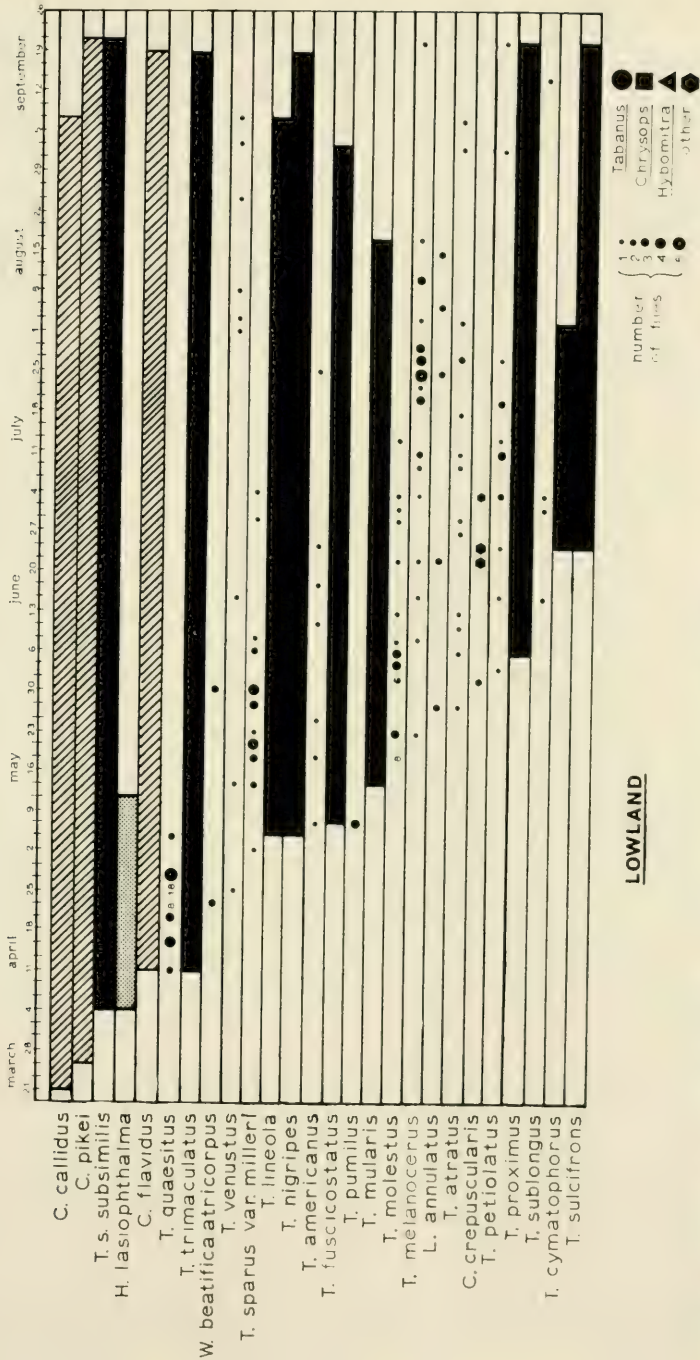


Fig. 3. Seasonal succession and range of 26 species of Tabanidae, lowland locale, Brazos County, Texas, 1975.

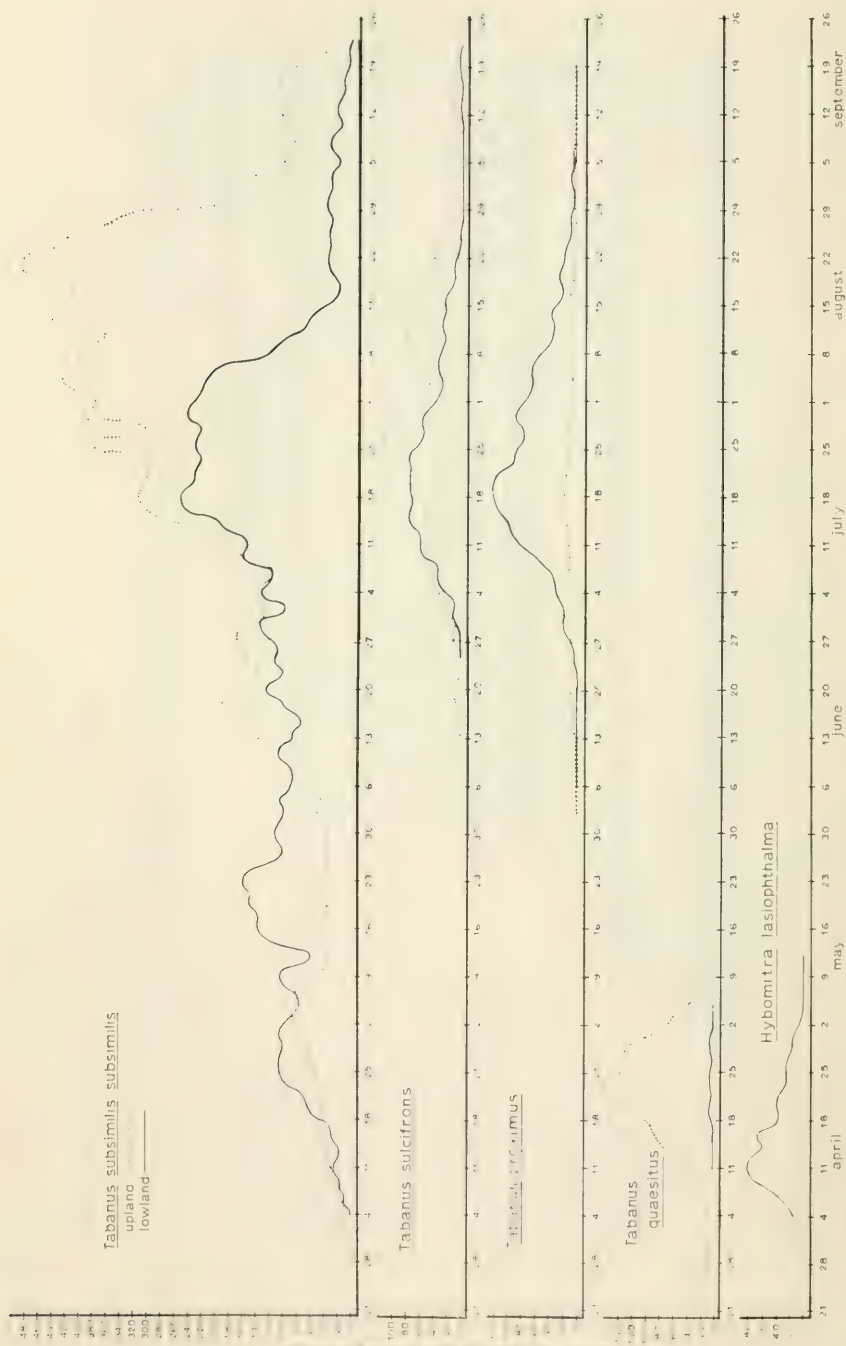


Fig. 4. Seasonal distribution of some dominant species, upland and lowland locales, Brazos County, Texas, 1975.

Table 2. Rank and proportion of total populations, dominant and subdominant species, upland and lowland communities.

Uplands				Lowlands			
Species rank	No.	%	Cum. %	Species rank	No.	%	Cum. %
<i>T. s. subsimilis</i>	12,642	72.8	72.8	<i>T. s. subsimilis</i>	7,172	55.9	55.9
<i>sulcifrons</i>	1,831	10.6	83.4	<i>proximus</i>	1,648	12.8	68.7
<i>quaesitus</i>	1,236	7.1	90.5	<i>sulcifrons</i>	1,059	8.3	77.0
<i>mularis</i>	318	1.8	92.3	<i>fuscicostatus</i>	686	5.3	82.3
<i>proximus</i>	316	1.8	94.1	<i>H. lasiophthalma</i>	576	4.5	86.8
<i>C. callidus</i>	283	1.6	95.7	<i>T. lineola</i>	555	4.3	91.1
<i>pikei</i>	266	1.5	97.2	<i>C. pikei</i>	310	2.4	93.5
<i>T. trimaculatus</i>	235	1.4	98.6	<i>T. trimaculatus</i>	256	2.0	95.5
Remaining 18 spp.	243	1.4	100.0	Remaining 18 spp.	578	4.5	100.0

Discussion and Conclusions

Seasonal aspects (Figs. 2 and 3).—At both sites, the earliest vernal species of late March and early April were the three most numerous *Chrysops* taken, *Tabanus s. subsimilis*, and *Hybomitra lasiophthalma* (Macquart). These were followed in late April and in May by *Whitneyomyia*, *Leucotabanus*, and *Tabanus molestus* Say, *T. mularis* Stone, *T. trimaculatus* Palisot de Beauvois, and *T. venustus* Osten Sacken. June brought the aestival *Chlorotabanus crepuscularis* (Beq.) and the largest species of horse flies, *Tabanus proximus*, *T. cymatophorus* Osten Sacken, and *T. sulcifrons*.

Differences in the time of appearance between those species common to the two locales were negligible, in most cases. The largest differences of 30 days or more occurred between species much more abundant at one locality than at the other. Specifically, populations of *Tabanus fuscicostatus* Hine, *T. lineola* F., and *T. nigripes* Wiedemann were much more numerous (18-98×) in the lowlands than in the uplands; therefore, their much earlier collection dates at the river. *Tabanus atratus* F. appeared in late May at the river but has been recorded from March through November in Texas collections.

Productivity.—Based only upon the ratio of total catches, the upland site produced 26% more tabanid material than the lowland one. Although lowland ecosystems are potentially more productive, runoff on river floodplains causes traumatic flooding of large breeding areas and decimates large fly populations. This is probably most true for populations of riparian and marginal forms which include the majority of species in such communities and which concentrate in low areas for moisture during summer drought.

Comparison of upland and lowland populations of *T. s. subsimilis* (Fig. 4) shows that 1 August marked the abrupt decline of this species in catches at the river while catches in the uplands continued to increase for 3 weeks

after that. August–September catches in the uplands included 50% of the seasonal catch there whereas those on the river included only 20%. Flood stage conditions on the Navasota in late August continued through September 8 and a boat was necessary to retrieve catches during most of this period.

As seen in this study, more of the numerous species in upland communities can be expected to have broader adaptive limits regarding breeding habitat. These data show that the four spp. predominating in the post oak ridge community (92.3% of the total catch, Table 2) were just such forms (*T. s. subsimilis* and *T. sulcifrons*); or species believed to breed primarily in well-drained soils because they have not been collected in wet soils (*T. mularis* and *T. quaesitus*).

By contrast, the lowland abundants included species that predominate in, or characterize, river floodplains (*T. fuscicostatus*, *T. lineola*, and *Hybomitra lasiophthalma*). Also, *Tabanus proximus* is known from floodplains in moist soils (Tidwell, 1973) or in marginal sites there (Thompson et al., 1977); the latter niche probably supports this species in the uplands. Finally, the dominance of *T. subsimilis subsimilis* and *T. sulcifrons* in both ecosystems only substantiates these forms as ubiquitous species here, as in other ecosystems throughout their range.

Relative abundance.—Four species were found in one community in large numbers but were nearly absent in the other. These are probably characteristic species—those predominating in certain kinds of ecosystems, although not confined to them. Catches of three of these, *T. fuscicostatus*, *T. lineola*, and *Hybomitra lasiophthalma*, included 14.1% of the material taken on the Navasota floodplain but only 0.2%, collectively, of that found in the uplands. These data from the Navasota River locale substantiate other collection data of adults in the literature that *Tabanus fuscicostatus* and *Hybomitra lasiophthalma* are characteristically riverine; *Tabanus lineola* has been recorded from varied upland and lowland communities but is much more abundant on river floodplains. Conversely, these three horse fly species probably appeared in the upland locale 12 mi from the river only as immigrants.

The fourth species, *T. quaesitus*, was very numerous on the post oak ridges but was found in only small numbers on the river (7.1% vs. 0.3%). Until recent years, this species was known from little material. *Tabanus quaesitus* is now common in catches from southeast Texas and very abundant in Gulf coastal prairie locales near Victoria (Thompson, Blume, and Aga, 1976). Because the larval habitat is apparently unknown, the recorded collection history fails to explain the difference in catches between the two communities described here.

Tabanus sulcifrons and *T. s. subsimilis* were among the three most abundant dominants at each community. *Tabanus sulcifrons* has been reported

from a great variety of diverse habitats, most having dry, mineral soils. (The occurrence of specimens from swamp beds and margins, drainage ditch banks, and stream riffles, linked with morphological considerations, suggests *T. sulcifrons* is a complex of closely related species.) Similarly, *T. s. subsimilis* has been taken from a great diversity of habitats; most of these were found in Texas locales and most, like those of *T. sulcifrons*, from upland situations (Thompson, 1975). These data, and that on abundance, geographical distribution, and aseasonal appearance, suggest that *T. s. subsimilis* is highly successful throughout much of its range, an area that has greatly increased in the southern states in the last 20 years (L. L. Pechuman, personal communication).

The species common at both locales are found throughout different ecosystems of the Coastal Plain; most have been taken as larvae from several lowland situations, including in this study, habitats near the river trap sites (Table 1). The larva of *T. mularis*, like those of the closely related *T. fuscicostatus* and *T. quinquevittatus* Wiedemann, is probably not dependent upon surface habitats having standing water except during summer periods of drought.

Incidence and diversity.—The typical picture of species diversity in a community is one of few rare species, few abundant ones, and a number of common forms more numerous than either of those groups. Although 21 species were incident to both study areas, the riverine fauna was more diverse. Of the five species found only in upland collections in 1975 (*Silvius quadrivittatus texanus* Pechuman, *Chrysops montanus* Osten Sacken, *C. virgulatus* Bellardi, *Tabanus colombensis* Macquart, and *T. eurycerus* Philip), all but *Chrysops montanus* established new locality records and the first three had been recorded from the lowland site in past years. Also, the five species found only on the floodplain in 1975 (*Tabanus americanus* Forster, *T. petiolatus* Hine, *T. pumilis* Macquart, *T. sparus* var. *milleri* Whitney, and *T. sublongus* Stone) were not taken at the upland site in previous years but were taken on the floodplain then. The net result of these annual and geographic differences in incidence is the probable occurrence of eight more resident species in the lowlands than in the uplands, and thus again, more diversity there. Expectedly, the riverine ecosystem is physically more complex and offers more habitat niches.

Although most distributions of animal species cannot be causally related with those of plant species, they can be studied through relating them to types of vegetation and its life form. Such descriptive information for some insects can provide insight into the probable distributions of other species by using recorded histories of association together. These associations for tying species of Tabanidae together, and then to vegetation and life form, will await additional long-term seasonal collections for different ecosystems.

Acknowledgments

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NEW RECORDS AND NAME CHANGES OF
NORTH AMERICAN LYGAEIDAE
(HEMIPTERA: HETEROPTERA: LYGAEIDAE)¹

Peter D. Ashlock

Abstract.—*Lygaeus trux* Stål is removed from the list of U.S. Lygaeidae; *Nysius niger* Baker is shown to be the correct name for *N. ericae*, Amer. auct., not Schilling; *Nysius scutellatus* Dallas and *Lamprodema maura* (Fabricius) are newly recorded from North America north of Mexico; *Neosuris castanea fraterna* Barber is synonymized with *Neosuris castanea* (Barber); new state records are recorded for *Ochrimnus lineoloides* (Slater), *Bathydema punctata* (Distant), *Megalonotus sabulicola* (Thomson), *Neosuris castanea* (Barber), *Carpilis barberi* (Blatchley), and *Zeropamera nigra* Barber.

The following new records and synonymies of and deletions from the U.S. lygaeid fauna are presented now so that they may be included in a forthcoming catalogue of the Heteroptera of America north of Mexico.

Lygaeus trux Stål

Lygaeus trux was reported for the first time as a member of the U.S. fauna by Torre-Bueno (1946:13) in part III of his "Synopsis of the Hemiptera-Heteroptera of America north of Mexico." He listed the species from Arizona and Mexico with no further data. In the Torre-Bueno collection, which is now in the Snow Entomological Museum, University of Kansas, there is a male specimen labeled by Torre-Bueno as *Lygaeus* (*Lygaeus*) *trux* Stål with an additional note: "specimen in synopsis key." The locality label reads "Baboquivari Mt., 18-XI-34, Ariz.," a locality in Pima County about 50 miles southwest of Tucson. The specimen is not *L. trux* at all; it appears to be a slightly teneral specimen of *L. reclinatus* Say. *Lygaeus trux* is characterized by a Y-shaped red fascia on the head with arms that reach the antenniferous tubercle, and by a dull orange corium with a black spot in the middle, independent of the lateral black area. *Lygaeus reclinatus* has a quadrate spot on the base of the head, and the central spot on the corium is included in or contiguous with the lateral black area. Both species have the clavus predominantly red with a black spot behind the middle. Torre-Bueno's specimen has a very slightly bifurcate red quadrate spot on the base of the head, and the corial spot is contiguous with the lateral black area. The corium is a bright red more characteristic of *reclinatus* than of the dull orange *trux*. That Torre-Bueno's specimen is teneral is indicated by its very dark red appendages; black ones are char-

acteristic of adults of both species. Thus it would appear that *Lygaeus trux* should be removed from the list of U.S. species.

Ochrimnus lineoloides (Slater)

This species is listed in Slater's (1964) catalogue from Virginia to Florida as well as Texas, New Mexico, and Guadeloupe Island. To these localities must be added New Jersey: Cape May, Cape May Co., New Jersey, 21-VIII-69, P. D. Ashlock, coll.

Nysius niger Baker

In 1908, Horváth listed as Holarctic the widespread European species *Nysius ericae* (Schilling). Ever since, this North American insect, also known as the "false chinch bug," has gone under the name *ericae*. I have compared European specimens (identified with the aid of Wagner, 1958) and North American specimens (keyed in Barber, 1947), and find that the two forms are not identical. Moreover, I can find no evidence that the European *N. ericae* is found in the Western Hemisphere. Hence, another name must be found for the North American species.

Barber (1947) in his treatment of the genus *Nysius* of the United States and Canada, on the advice of the late R. L. Usinger who studied Baker's types, synonymized *Nysius angustatus* var. *niger* Baker with *Nysius ericae* (Schilling). Baker's variety is the only available name for the North American species, which now must be called *Nysius niger* Baker. Barber selected a female lectotype from Baker's cotype series labelled "Wash. No. 2508."

Barber (1947) lists the species (as *N. ericae*) as occurring in the "entire Dominion of Canada from New Brunswick to British Columbia and in the United States from Maine to Washington, Oregon and northern California." He also mentions that the range overlaps that of *N. raphanus* Howard in Kansas. I have identified the species from Point Barrow, Alaska, Sonora Pass, California, and northern Arizona and New Mexico in the west. In the east, the species has been collected also in New Hampshire, Connecticut, and New York.

Although *N. ericae* and *N. niger* are very similar, a trained eye can distinguish the two when they are placed side by side. The best evidence for the two being distinct can be found in the female spermatheca (Fig. 1). In *N. ericae* the duct just basal to the terminal bulb is in a tight coil for about three and a half turns, and the enlarged basal part of the coil is longer and thicker. In *N. niger* this coil is more open, irregular, and makes about one and a half turns; the basal enlarged portion of the coil is much shorter and narrower. The spermatheca in species of *Nysius* is a pigmented structure that holds its shape when studied under glycerine. In

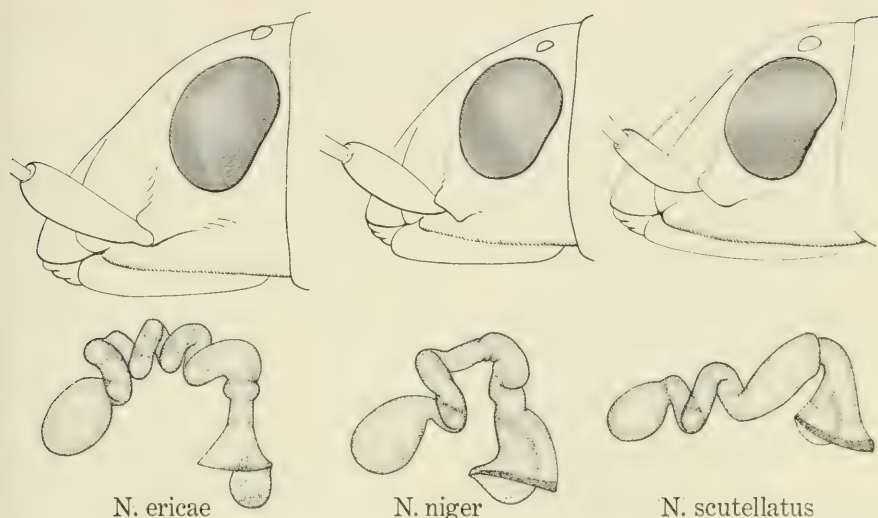


Fig. 1. Lateral view of head (upper) and spermatheca (lower) of named species of *Nysius*.

investigating several specimens of each species, I have found some variation, but none that would result in confusion of the two species. Investigations of the spermatheca of many species of *Nysius* from all over the world demonstrate that each species has a distinctively shaped spermatheca. The inflated aedeagus also demonstrates the distinctness of the two species, the differences being found in the lobes of the vesica.

The common name "false chinch bug" was first used by Bruner and Barber (1894) for insects sent in to be infected with "chinch bug disease" which turned out not to be chinch bugs. The common name was said to be specifically applied to *Nysius angustatus* Uhler, but because of the short pronotum the figure (credited to Riley) is clearly the species known as *Nysius raphanus* Howard. Milliken (1918) in discussing the false chinch bug under the name *Nysius ericae* as an agricultural pest gave an original figure which is also *N. raphanus*. *Nysius raphanus* is the most serious pest among North American species of *Nysius*, and if any species deserves a common name, it is this one.

Nysius scutellatus Dallas

Nysius scutellatus was described by Dallas (1852) from Jamaica, and has since been reported from the Bahamas, Puerto Rico, and several other islands of the greater and lesser Antilles. Comparison of *N. scutellatus* with

specimens resembling *N. niger* from the southeastern states shows that *Nysius scutellatus* must be added to the U.S. list of species. I have found specimens in many localities in Virginia, North and South Carolina, Georgia, and Florida. *Nysius scutellatus* is very similar to *N. niger* but can be separated externally by its longer bucculae, which project downward much less than those of *N. niger* and are less tapered. To see the difference, it may be necessary to remove some of the hairs that obscure the area where the bucculae attach to the head. The spermatheca (Fig. 1) again demonstrates the differences between the two species most clearly. In *N. scutellatus* there are, as in *N. niger*, about one and a half coils in the duct, but these are tight and regular, and the basal enlarged part of the coil is larger than that of either *N. niger* or *N. ericae*.

Plinthisus martini Van Duzee

Torre-Bueno (1944) synonymized this species with *Plinthisus longisetosus* Barber, stating "On the face of the descriptions, the two species are one and the same." Torre-Bueno did not see the type-specimens of these species, and Van Duzee's description (1921) made no comparison with Barber's 1918 description. I have seen the types of both, and they are distinct from one another. It would be misleading to try to verbalize the distinctions between the two, however. These two species, along with *P. pallidus* Barber, are part of a difficult complex of species, all very similar and found in California and Oregon, that may amount to more than ten species, judging from the material at hand. None is more than 2 mm long, all are brachypterous and membraneless, and all have the coria truncate or nearly so posteriorly. Most of my material is from the San Francisco Bay area, but I have specimens from Curry County, Oregon, and Lake Tahoe, California, in the Sierra Nevada Mountains. Barber's *P. pallidus* was described from Los Angeles. I am resurrecting *P. martini* because it is better to include all valid described species in the forthcoming catalogue, but the genus needs extensive collecting and careful revision before characterizations will be of any value.

Bathydema punctata (Distant)

Distant (1893) described this species as *Salacia* (?) *punctata* from Panama. To date, the only other record has been that of Banks (1910), who listed *Cligenes punctata* (Distant) from "Tex." Many of the records from the Banks catalogue are erroneous, and I know of no extant voucher specimen for his record. It was of great interest to receive from Mr. C. L. Smith of the University of Georgia a single male specimen with the following data: Ga., Baker Co., pond off Rte. 37, 2.4 mi W Newton, 11-IV-75. C. L. Smith, coll. This species was placed in *Antilocoris* by Van Duzee

(1916) where it is listed in Slater's 1964 catalogue. Ashlock (1964) placed it in *Bathydema*.

Megalonotus sabulicola (Thomson)

This widely distributed European species was first reported in North America by Van Duzee (1928) under the name *Rhyparochromus chiragra* var. *californicus* Van Duzee, from specimens collected in 1921 in Albany, California, and other localities near San Francisco. Slater and Sweet (1958) reported the species from several localities in Connecticut, first collected in 1957. Because it has also been intercepted at quarantine in Washington, D.C., and Philadelphia, Pa., and a comparison with specimens from western North America yielded no essential differences, Van Duzee's variety was synonymized. Scudder (1961) and Sweet (1964—with a grammatical correction by Steyskal, 1973)—have established that *Megalonotus sabulicola* (Thomson) is the correct name for the species found in North America.

Scudder (1961) reported the species from British Columbia (earliest record, Duncon, 1-X-32), and with no other data from Seattle, Washington. During the 1950's I also was attempting to establish the synonymy of Van Duzee's variety; as a part of this study, I gathered all the available records to establish the spread of the species from California. Even though this procedure is suspect because it depends on the fortunes and spread of collectors, it is about the only one to suit the purpose. The data thus collected is instructive and includes three new state records. The most significant records are: Oregon: Portland, Corvallis, Dever, Seio, all 1931; Washington: Seattle, 1933; California: La Jolla, Escondido, 1941; Idaho: Lenore, 1948, Cassia, 1954; Utah: Logan Canyon, 1957. The distribution of the species is now from southern California north to British Columbia, east through northern Idaho and southern Idaho to northern Utah, with a disjunct distribution in Connecticut. The Oregon, Idaho, and Utah records have not previously been published.

Lamprodema maura (Fabricius)

This species is known from many localities in Europe, but seems to have become established in southern California, as the following two records indicate: California, Orange Co., S. Huntington Beach, 22-XII-65, ex. ear of corn, John Cloot & Duane Cork, colls.; California, Los Angeles Co., Long Beach, 22-III-60, J. K. Drew, coll. An additional specimen was found in the Snow Entomological Museum with the data: Truro, N.S. [Nova Scotia?], 5-IX-13. The fact that the two North American localities for this common European species are so far apart and coastal probably indicates that the species has been introduced into North America twice.

Neosuris castanea (Barber)

Esuris castanea Barber, 1911, J. New York Entomol. Soc. 19(1):27-28.

Neosuris castanea (Barber), 1924, J. New York Entomol. Soc. 32(3):133-134.

Neosuris castanea fraterna (Barber), 1948b, Psyche. 55(2):86. New synonymy.

Barber cited as characters for the subspecies some differences in punctuation, and the fact that, although variable, the specimens of the subspecies tended to be darker than those of the nominate form. I have studied the holotype and paratypes of *castanea*, paratypes of *fraterna*, and a series from Utah that Barber identified as *fraterna*, and find that the within-population variation covers the full range of both forms. There seems no taxonomic way to delimit geographic subdivisions of the species. A second series from Alameda County, California, further demonstrates this inherent variability: individuals vary from a middle castaneous to nearly black, but always retain the white apical margin of the corium. The species has been recorded from Arizona, Colorado, and Idaho, so the Utah and California records are new. The pertinent records are: Utah: Tooele Co., Tooele Ordinance Depot, 16-V-53, 20-VI-53, 22-VIII-53, 19-IX-54, under grass, P. D. Ashlock, coll.; California: Alameda Co., 20-VIII-54, under grass and low herbs, P. D. Ashlock, coll.; San Diego Co., Descanso Jct., 31-III-61, E. E. Lindquist, coll.

Carpilis barberi (Blatchley)

Blatchley (1926) described this species from two localities in Florida as *Ptochiomera barberi*. I collected a single female in plant litter near the beach in North Carolina, Brunswick Co., Ocean Isle Beach, 9-VII-60.

Zeropamera nigra Barber

This species was described by Barber (1948a) from a type male from California, Mt. Wilson, Los Angeles Co., and two paratype females from Sequoia National Park, California. No further records have been published. A single specimen, seen by both myself and Mr. H. G. Barber, but since lost, constitutes a new state record: Utah: Tooele Co., Dugway Proving Ground, Granite Mt., ex nest of *Neotoma*, 20-IV-53, A. Gastfriend, coll. Whether the pack rat nest is the preferred habitat of *Zeropamera nigra* is not known. I have seen many specimens of Lygaeidae collected from *Neotoma* nests in southern California and Mexico by R. E. Ryckman, and *Zeropamera* was not among them. One additional male specimen of *Z. nigra* is in my collection, kindness of the collector: California, San Bernardino Co., Camp Baldy, 28-VI-62, G. L. Wiley, coll.

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Footnote

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NOTE

LUTZOMYIA VEXATOR (COQUILLET) IN CONNECTICUT
(DIPTERA: PSYCHODIDAE)

During the summer of 1976, New Jersey and CDC light traps (for biting flies) were operated at thirteen sites in south central Connecticut five nights weekly from 26 May to 30 September.

Included in the catch were five specimens of *Lutzomyia vexator* (Coquillett), a species (and genus) previously unknown from the New England area. The collections were as follows: Millington, East Haddam (M. L. Green property, Smith Road), 15 July (1♂): *ibid.*, 16 July (1♂, 1♀): *ibid.*, 21 July (1♂). North Madison (D. D. Wilson property, Summer Hill Road), 25 July (1♀). The Wilson site is approximately 18 miles SW of Green's. Both areas are heavily wooded (oak-maple) with fresh-water swamps nearby.

Heretofore *L. vexator* has not been seen north of the type-locality, Plummer's Island, Maryland, except for one female taken at dusk 21 July 1971 by Downes (1972, Can. Entomol. 104:1135-1136) at Black Lake near Perth, Ontario, in the Rideau Lake region. The latitude of the Canadian locality is approximately 285 mi north of the Connecticut collection sites. Specimens have been deposited in the insect collections of the U.S. National Museum, Yale University and University of Florida.

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TWO NEW SPECIES OF FOSSIL MAYFLIES
(EPHEMEROPTERA: NEOEPHEMERIDAE AND SIPHLONURIDAE)
FROM THE RUBY RIVER BASIN (OLIGOCENE)
OF SOUTHWESTERN MONTANA¹

Standley E. Lewis

Abstract.—Two new species of mayflies, *Potamanthellus rubiensis* (Neoephemeridae) and *Isonychia alderensis* (Siphonuridae) are described from the paper shales of the Ruby River Basin (Oligocene) of southwestern Montana. These are the first to be described from this formation.

Sixteen fossil impressions of immature mayflies (Ephemeroptera: Neoephemeridae and Siphonuridae) have been discovered from the paper shale deposits of the Ruby River Basin of S.W. Montana. Fifteen of the sixteen specimens belong to the family Neoephemeridae and represent a new species of the genus *Potamanthellus* Lestage. It is significant to note that the living *Potamanthellus* nymph is yet undescribed, but the fossils appear congeneric with extant nymphs of *Potamanthellus* in the collections of the University of Utah (personal communication, Edmunds, 1974). The other specimen found belongs to the family Siphonuridae and represents a new species of the genus *Isonychia* Eaton. These two new species represent the first members of either family to be described from this locality. The fossils were found in paper shale deposits of Oligocene age between Peterson and Mormon Creeks, Sec. 23, T7S, R5W, Madison County, Montana. A brief description of the geologic history of this region can be found in a previous paper (Lewis, 1971).

Systematic Description

Order Ephemeroptera

Family Neoephemeridae

Subfamily Neoephemerinae

Potamanthellus rubiensis Lewis, new species

(Fig. 1)

Described from a dorsal view of an incomplete mayfly nymph with parts of legs and caudal filaments obscured or missing in preservation. Body light brown in color with some detail missing. Legs extended outward in preservation. Length of body 12.0 mm; width of body at widest point 2.5 mm.

Head.—Head brown in color. Eyes large and somewhat circular in shape (.6 mm across). Antennae not visible. Slight median ridge present between eyes. Length and width of head 1.0 mm and 1.7 mm respectively.



Fig. 1. *Potamanthellus rubiensis*, dorsal view of complete nymph (7.0 $\times$).

Thorax.—Prothorax 1.2 mm in length and 2.0 mm in width at widest point. Pronotum somewhat rectangular in shape with anterior margin slightly concave; anterolateral covers of pronotum slightly pointed. Prothoracic femur complete and stout. Proximal $\frac{1}{2}$ of prothoracic tibia present. All thoracic legs showing a mottled color pattern. Each tarsal claw long, slender and edentate. Metathoracic wing pads large measuring 3.4 mm in length. Posterior margin of the dorsal portion of the metathorax with no minute, median, backward projecting spine visible.

Abdomen.—Length and width of abdomen 6.8 mm and 2.2 mm respectively. A pair of elyroid gill on 2nd segment, covering the gills of the 4 following abdominal segments. Abdominal segments 6–8 with minute

dorsal median backward-projecting spines. (This single feature not visible on holotype, but evident on specimen RR4-1.) Lateral posterior margins of abdominal segments pointed. All caudal filaments well developed. Median caudal filament approximately 5.0 mm in length. Short spines not visible on any of the filaments (this is probably due to preservation).

Discussion.—The larval form described above is definitely a caenid-type. In the present day fauna, this caenid-type of larvae is characterized by two families: Caenidae and Neophemeridae.

Larval forms of these two families are distinguished by the degree of development of the metathoracic wing pads, the overall body length, and the presence or absence of thoracic and abdominal carinae (Edmunds et al., 1963). The specimens found at the Ruby River sites show a well-developed metathoracic wing pad, a longer body length and a median carina on abdominal segments 6–8. The specimens show no distinct pronotal carina terminating at the anterolateral angles. These morphological features are all indicative of the family Neophemeridae. Because of their size and morphology, the larvae described in this paper belong to the family Neophemeridae (body length of present-day forms: 8–17 mm) and not in the family Caenidae (body length of present-day larvae: 3–7 mm).

Type-material.—Holotype: No. B-60. Found near Alder, Montana, by H. F. Becker; 196?. Oligocene sediments of the Ruby River Basin; reverse absent. Paratypes: Nos. B-13, B-20, B-58 (reserve present), B-59, B-61, B-62, C-1 (reverse present), C-2, RR-1-34, RR-4-1, 6-40, 6-117, 6-23 and 6-290, all found near Alder, Montana, by H. F. Becker; 196?. Oligocene sediments of the Ruby River Basin. Specimens maintained temporarily with S. E. Lewis Biology Department, St. Cloud State University, St. Cloud, Minnesota 56301.

Order Ephemeroptera

Family Siphonuridae

Subfamily Isonychiinae

Isonychia alderensis Lewis, new species

(Fig. 2)

Described from a lateral view of a complete nymph with head and legs somewhat obscured. Body light brown in color with little differentiation from the rock material that surrounds it. Length of body (excluding caudal filaments) 13.40 mm; width of body at widest point 3.17 mm.

Head.—Head ovoid in lateral perspective. Eyes also ovoid in shape, measuring .90 mm in length and .48 mm in width. Antennae not distinguishable. Maxillary gill tufts present. Length and width of head: 3.6 mm and 2.2 mm respectively.

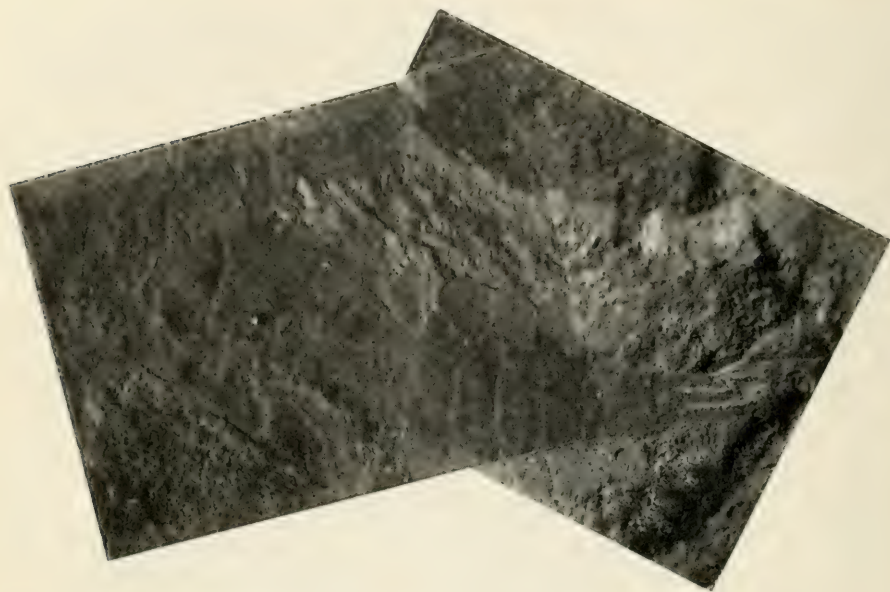


Fig. 2. *Isonychia alderensis*, lateral view of complete nymph (8.1 $\times$).

Thorax.—Prothorax somewhat triangular in shape from lateral view. Length of prothorax .98 mm. Other thoracic regions not distinct. Total length of thorax approximately 4.0 mm. Thoracic appendages not well preserved. Fore coxal gill tufts not visible.

Abdomen.—Length and width of abdomen 7.3 mm and 2.9 mm respectively. Plate-like gills visible on abdominal segments 1–7. When not visible on both sides, poor preservation is indicated. Ventral fibrillar tufts of abdominal gills not preserved. Three well-developed caudal filaments. Dense fringe of setae on inner side of each cercus not preserved.

Type-material.—Holotype: No. C-3. Found near Alder, Montana, by H. F. Becker; 1962. Oligocene sediments of the Ruby River Basin; reverse absent. Specimen maintained temporarily with S. E. Lewis, Biology Department, St. Cloud State University, St. Cloud, Minnesota 56301.

Discussion.—This nymph bears definite maxillary gills, with fore coxal gills strongly suspected but not preserved. Each abdominal gill is composed of a plate-like dorsal element and probable ventral fibrillar tufts—the latter strongly suspected, but not preserved. These morphological features indicate the placement of this specimen into the subfamily Isonychiinae. The dorsal plate-like portion of the abdominal gills do closely resemble species of the genus *Isonychia* Eaton (Burks, 1953, fig. 225).

Because of the morphological similarities to the genus *Isonychia*, the specimen is placed in this genus. Due to the geologic age, this fossil nymph warrants recognition as a new species.

The present-day nymphs of this genus are streamlined, vigorous swimmers which develop in fast moving creeks and small rivers. Although they are known to be predaceous, they feed primarily on algae and vegetative detritus. The nymphs inhabit a wide variety of streams and rivers in the Holarctic and Oriental regions and have been found as far south as Veracruz Province in Mexico (Edmunds et al., 1963).

Acknowledgments

I wish to thank H. F. Becker of the New York Botanical Gardens and G. F. Edmunds of the University of Utah for the loan of these fossils. This field research was funded through grants from the Geological Society of America, Society of Sigma Xi and the St. Cloud State University Institutional Research Fund.

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Footnote

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A NEW NAME AND RESTORATION OF AN OLD
NAME IN THE GENUS *FULVIUS* STÅL
(HEMIPTERA: MIRIDAE)¹

A. G. Wheeler, Jr.

Abstract.—*Fulvius slateri*, new name, is proposed in the family Miridae as a replacement name for *F. brunneus* of authors, not Provancher, 1872. *Fulvius brevicornis* Reuter (1895a) is shown to be an unnecessary new name, and *F. anthocoroides* Reuter (1875) is restored.

The name *Fulvius brunneus* (Provancher) was used in a recent review of the Miridae in Wirtner's (1904) list of western Pennsylvania Hemiptera (Wheeler and Henry, 1977). In a footnote it was indicated that a decision on the validity of Provancher's name would be forthcoming. A review of pertinent literature has revealed that a new name is necessary for *F. brunneus* of authors.

Peripheral to the renaming of *F. brunneus* of authors, I found additional nomenclatural problems in the genus which are deserving of mention: That Reuter's *F. brevicornis* 1895a is an unnecessary new name for his own *F. anthocoroides* 1875; that *F. uhleri* Reuter 1895a is an overlooked name; and that the establishment of *F. brunneus* Provancher 1872 as a junior synonym of *Plagiognathus obscurus* Uhler 1872 (Kelton, 1968) necessitates an attempt to date these two 1872 publications.

Fulvius slateri Wheeler, new name

Lygus brunneus, Uhler, 1886:18, and authors, not Provancher, 1872:104.

Pamerocoris anthocoroides, Uhler, 1877:425 (preoccupied).

Fulvius anthocoroides, Van Duzee, 1889:4.

Fulvius brunneus, Reuter, 1895a:140.

Provancher's (1872) original description of *brunneus* is incomplete and vague. Kelton (1968) reviewed the problems encountered in attempting to establish the identity of Provancher's species of Hemiptera and stated that his descriptions often were based on single specimens, that types were not designated, that different catalogue numbers were sometimes assigned to the same species, and that from time to time his collection was "revised." Van Duzee (1912) and Kelton (1968) re-examined the Provancher collection and came to slightly different conclusions regarding the status of *F. brunneus*. Van Duzee stated that the specimen labeled as *brunneus* was an example of *Plagiognathus politus* Uhler. However, since Provancher's description did not fit a species of *Plagiognathus*, Van Duzee believed that the original specimen had been lost and one of

P. politus substituted. Kelton (1968) found that the specimens of *brunneus* in the Provancher collection were *Plagiognathus obscurus* Uhler. He considered that Provancher's original description closely fit *P. obscurus* and pointed out that the statement by Provancher that *brunneus* is common on plants is more characteristic of *Plagiognathus* species than of *Fulvius* species, which are usually collected on fungus-covered trees and logs. He therefore synonymized Provancher's species under *P. obscurus* and designated a male as lectotype. The U.S. National Museum collection has an additional Provancher specimen labeled as *brunneus* (catalogue no. 33) which also is *P. obscurus*. I am following Kelton's opinion because of the vagueness of Provancher's original description and because of his lectotype designation. This action by Kelton leaves *F. brunneus* of authors, not Provancher, without a name.

The next available name for *F. brunneus* of authors is *anthocoroides* Uhler 1877, described in the genus *Pamerocoris* and based on specimens from Ontario (Grimsby), Colorado (Denver), Maryland (Baltimore), and eastern Massachusetts. Provancher himself (1887) synonymized Uhler's name under his own *P. brunneus*, apparently basing his decision on the similarity of the scutellum and cuneus in the two descriptions and possibly also because Uhler had a Canadian specimen in his type-series. However, Provancher erred in establishing that synonymy; Uhler's species belongs to the genus *Fulvius* rather than to *Plagiognathus*. His name *anthocoroides* is available but is a junior secondary homonym of *Fulvius anthocoroides* (Reuter, 1875).

The new name *F. slateri* is being proposed for *F. brunneus* of authors and for Uhler's preoccupied name, *anthocoroides*. As lectotype of Uhler's *P. anthocoroides*, I am designating a specimen found in the U.S. National Museum's Type Collection, labeled in Uhler's handwriting, and without much doubt the specimen from Grimsby listed in his original description. The specimen, a female, has been assigned USNM Type No. 75318 and is labeled: Grimsby (handwritten); 2.507 (pink); 3. PR Uhler Collection; 4. *Pamerocoris* (underlined) *anthocoroides* Uhler—Canada (handwritten); 5. *Pamerocoris* (underlined) *anthocoroides* Uhler—Canada (black bordered).

Fulvius slateri is named in honor of the well-known hemipterist and lygaeid specialist at the University of Connecticut, Dr. James A. Slater, who first recognized the need of a replacement name for *F. brunneus* of authors.

Fulvius anthocoroides (Reuter)

Teratodella anthocoroides Reuter, 1875:8.

Fulvius brevicornis Reuter, 1895a:138 (unnecessary new name).

Stål (1862:322) described *F. anthocorides* (a species distinct from *F. anthocoroides* Reuter 1875) but Walker (1873:160) spelled Stål's name as *anthocoroides*. Under Article 33b of the Code, this constitutes an "incorrect subsequent spelling," although Hussey (1954) referred to it as an emendation. With the exceptions of Distant (1883:281) and Bergroth (1920:75) subsequent authors have followed Walker. Hussey (1954) stated that Stål's original spelling *anthocorides* is "grammatically and orthographically correct." The two spellings are not variable spellings under Article 58 of the Code, and thus *F. brevicornis* Reuter 1895a is an unnecessary new name for *F. anthocoroides* Reuter 1875. It might be argued that to have an *anthocorides* and an *anthocoroides* in the same genus leads to undue confusion and that an application for an exception to the Rules should be made to the International Commission on Zoological Nomenclature. However, these names have been seldom used in the literature and similar specific names in the same genus can be found scattered through zoological nomenclature.

Fulvius uhleri Reuter, An Overlooked Name

An overlooked name in the genus *Fulvius* and one that at first appeared to be available for *F. brunneus* of authors is *F. uhleri* Reuter 1895a. In his review of the genus *Fulvius*, Reuter (1895a) appears to have realized that *P. anthocoroides* Uhler belonged in *Fulvius* and that Uhler's name was preoccupied by his own (Reuter's) *anthocoroides* of 1875. He apparently was prepared to propose the new name *F. uhleri*, but Provancher's (1887) placement of *anthocoroides* Uhler as a synonym of *brunneus* rendered a replacement name unnecessary. Reuter (1895a) appears inadvertently to have left the name *uhleri* on p. 148 of his manuscript, although he replaced *uhleri* with *brunneus* on p. 136 of his key and on p. 140 in his discussion of species, as he later noted (Reuter, 1895b). On p. 148 Reuter states how his new species *F. dubius* differs from *uhleri*, cites specific characters for *dubius*, but does not validate the name *uhleri* by providing characters. Hence, *F. uhleri* is a *nomen nudum*.

Priority: *Plagiognathus politus* Uhler 1872 or
Fulvius brunneus (Provancher) 1872?

Kelton (1968) synonymized *F. brunneus* (Provancher) 1872 under *Plagiognathus obscurus* Uhler 1872 but made no mention of trying to determine priority of the two names. The Provancher paper appeared in the April 1872 number of *Naturaliste Canadien*, a copy of which at the USNM is stamped "April 26, 1872." The Uhler paper, published in U.S. Geologist F. V. Hayden's Fifth Annual Report of Progress, is for the year 1871 but is dated 1872. I found that the U.S. Geological Survey, the National Archives,

and the Government Printing Office were unable to supply a more precise date of publication.

Hayden's letter of transmittal to his Secretary of the Interior (p. 3) is dated 20 February 1872, and this may be the date the report was sent to Congress and thus date of publication. As internal evidence of date of publication is the copy of an Act of Congress establishing Yellowstone Park on 1 March 1872. In addition there is a supplement dated 7 May 1872 in which the main report is noted to have already been published. Since exact dates of publication could not be established, it seems logical to follow Kelton's (1968) decision, probably based on the fact that Uhler was a more careful worker in the Hemiptera than was Provancher, and the desire to maintain stability by retaining priority of the much-used name *Plagiognathus obscurus*.

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Footnote

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A NEW SPECIES OF *CENOCOELIUS* FROM COSTA RICA
(HYMENOPTERA: BRACONIDAE)

Barbara Saffer

Abstract.—A new species, *Cenocoelius andirae*, is described and is associated with *Andira* fruits in Costa Rica.

The specimens described below were collected by Daniel Janzen in Costa Rica during his studies of plant-insect relationships. They were found ovipositing in fruits of the leguminous tree, *Andira inermis*. All known species of *Cenocoelius* are parasitic on the larvae of Coleoptera. The beetles whose larvae live in the fruits and seeds of *Andira* in Costa Rica are *Cleogonus armatus* Champion, *C. rubetra* (F.), an as yet undetermined *Cleogonus* species, and *Apion samson* Sharp (D. R. Whitehead, personal communication). Whitehead believes that the species of *Cenocoelius* described below probably attacks all three species of *Cleogonus*, but he is not sure about *Apion*. Janzen has observed no other insect as a potential parasitoid of *Cleogonus* larvae in *Andira* fruits.

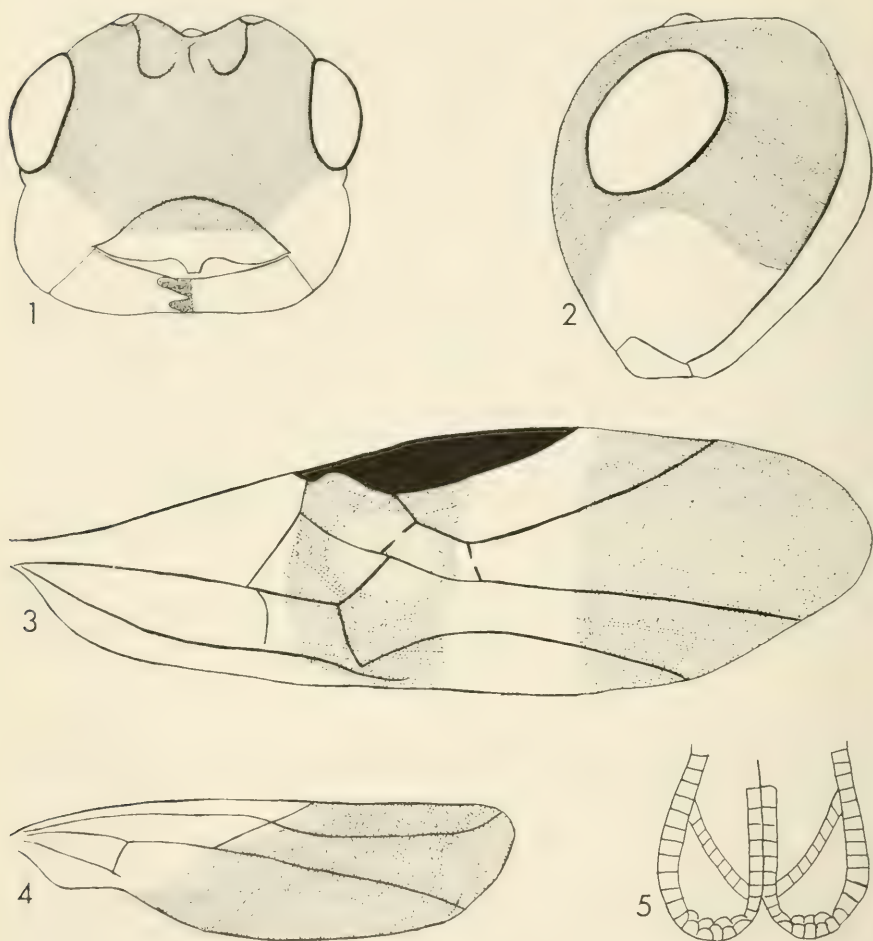
Cenocoelius andirae Saffer, new species
(Figs. 1-4)

Holotype.—Female, Costa Rica, Guanacaste Prov., Finca La Pacífica (about 7 km NW Cañas), 16-VII-75, found ovipositing in *Andira inermis* fruits (Janzen).

Description of type female.—Body length 9.2 mm; length of forewing 8.7 mm.

Head.—Antennae broken; right with 21, left with 26 flagellomeres remaining; scape $2.9\times$ as long as wide at apex, $1.81\times$ as long as basal flagellomere; face very weakly longitudinally rugose, closely punctate; clypeus sparsely punctate; apex of clypeus with large, median tooth (Fig. 1); malar space and temples smooth with a few punctures; mandible base wide, $0.96\times$ malar space; anterior vertex with broad, shallow, median, longitudinal depression, area on either side and slightly posterior to depression swollen; eye width $0.97\times$ temple width, eye height $1.26\times$ malar space; median ocellus located in a concavity; margins of temples and vertex adjacent to occipital carina smooth; outer margin of occipital carina considerably raised (Fig. 2).

Thorax.—Most of propleuron finely reticulately foveolate, the anterior end smooth; anterior, declivous part of prescutum with 3 smooth, longitudinal stripes; area lateral to stripes closely punctate; 2 strong, lateral, transverse carinae between anterior declivous and posterior parts of pre-



Figs. 1-5. *Cenocoelius andirae*. 1, front view of head, showing color pattern and large median tooth at apex of clypeus. 2, lateral view of head, showing color pattern. 3, forewing, showing color pattern. 4, hindwing, showing color pattern. 5, front view of proepisternum, showing diagonal row of foveae which bisects each lobe.

scutum; anterior and median part of posterior prescutum foveolate, the remainder smoother with a few punctures; scutum and scutellum smooth with very sparse punctation; lateral borders of scutum anteriorly weakly foveolate, posteriorly smooth; thorax width 1.86 · prescutum length; notauli foveolate, the foveae large; scutellar furrow with 6 foveae; sternaulus percurrent, composed almost entirely of a single row of foveae, the anterior end

irregularly foveolate; most of proepisternum sparsely punctate, each side with a short diagonal row of foveae between anterior $\frac{2}{3}$ and posterior $\frac{1}{3}$ (Fig. 5); extreme posterior end of proepisternum reticulately foveolate; propodeum foveolate, with a lateral, longitudinal row of foveae on each side; area ventral to longitudinal row more finely reticulately foveolate than remainder of propodeum; dorsal propodeum length $0.37\times$ thorax width; forewing with recurrent vein entering basal tip of 2nd cubital cell, nervulus slightly postfurcal; hindwing with 1st segment of mediella $1.47\times$ 2nd segment; hind tibia length $2.55\times$ hind basitarsus; last segment of hind tarsus $1.07\times$ 2nd segment; inner mid-tibial spur $1.06\times$ outer; inner hind-tibial spur $1.75\times$ outer; all tarsal claws with large, distinct basal tooth.

Abdomen.—First gastric segment smooth and shining, with very slightly embossed median area defined anteriorly by extremely short, lateral longitudinal carinae; 1st gastric tergum $1.27\times$ as long as wide at apex (not including epipleura); remainder of gaster smooth; ovipositor sheath $1.11\times$ as long as forewing.

Color.—Most of head, including antennae, black; malar space yellow; sharp diagonal line between black and yellow areas on each side of face, extending from base of eye to lower lateral edge of clypeus (Fig. 1); upper part of clypeus black, lower part yellow; mandibles yellow with upper lateral edge and apices black; occipital carina and palpi yellow; proepisternum black; remainder of thorax red, with small, black triangular sclerite beneath each forewing tegula; propodeum red; forewing yellowish red from tegula to base of 1st cubital cell, brown to apex of stigma, yellowish red to distal $\frac{1}{3}$ of radial cell, brown to apex (Fig. 3); hindwing with basal $\frac{2}{3}$ yellowish red, apical $\frac{1}{3}$ brown; irregular diagonal line in hindwing between yellowish red and brown areas (Fig. 4); stigma brown; color of venation corresponds to wing color; fore and mid coxae brown with reddish patches, remainder of fore and mid legs red with apices of last tarsal segments brown; hind legs black with yellow patches on coxae; hind tibiae densely covered with red hairs; gaster red with black patch on apex; ovipositor sheath black; ovipositor dark red.

Variation of paratype females.—Structure and sculpture: Antennae with 37 flagellomeres; scape $2.6\text{--}3.25\times$ as long as wide at apex, $1.53\text{--}2.43\times$ as long as basal flagellomere; mandible base $0.67\text{--}0.93\times$ malar space; eye width $0.84\text{--}1.0\times$ temple width; eye height $1.07\text{--}1.36\times$ malar space; posterior prescutum with anterior median area foveolate, the remainder smooth; lateral borders of scutum weakly foveolate; thorax width $1.85\text{--}2.18\times$ prescutum length; scutellar furrow with 5–7 foveae; sternaulus composed entirely of a single row of foveae; proepisternum posterior to diagonal rows of foveae transversely rugose and foveolate; lateral propodeum below longitudinal rows of foveae punctate, much smoother than remainder of

propodeum; dorsal propodeum length $0.33\text{--}0.45\times$ thorax width; nervulus postfurcal; hindwing with 1st segment of mediella $1.18\text{--}1.56\times$ 2nd segment; hind tibia length $1.58\text{--}3.2\times$ hind basitarsus; last segment of hind tarsus $1.13\text{--}1.4\times$ 2nd segment; inner mid-tibial spur $1.08\text{--}1.27\times$ outer, inner hind-tibial spur $1.5\text{--}1.8\times$ outer.

Color: Most of clypeus yellow with brown patches at base; lateral pronotum red with anterior dorsal part brown or black; mesopleuron completely black or with anterior $\frac{2}{3}$ black, the remainder red; most of mesosternum black with median reddish area; posterior prescutum and scutum black; scutellar furrow black; fore and mid legs: coxae red with brown shading, brown, or black, trochanters black, sometimes with red patches, femora black or red with large brown patches, tibiae red or almost entirely black with red apices, tarsi completely red with brown patches or with last segment black; gaster red with black apex.

Male.—Unknown.

Paratypes.—9 ♀♀, same data as holotype. Holotype and paratypes deposited in United States National Museum.

Discussion.—*Cenocoelius andirae* may be distinguished from other *Cenocoelius* by the following combination of characteristics: Color pattern of the face and wings (Figs. 1–4), the sculpture of the proepisternum, each lobe of which has a diagonal row of foveae (Fig. 5), the very large apical tooth of the clypeus, the broad based mandibles, and the extensively raised occipital carina.

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NOTES ON EXAMINATION OF TYPE-SPECIMENS OF
PSEUDOMELINA APICALIS MALLOCH AND *SEPEDON*
RELICTUS VAN DER WULP (DIPTERA: SCIOMYZIDAE)

Lloyd Knutson

Abstract.—The types of *Pseudomelina apicalis* and *Sepedon relictus* have been examined and the species are discussed.

Pherbellia apicalis (Malloch), 1933 (*Pseudomelina*), new combination

Pseudomelina apicalis was described as a new species and new genus by Malloch (1933) on the basis of one male from Puerto Montt, Llanquihue, Chile. Malloch stated, "Similar to *Melina* as represented in Patagonia, but propleural bristle lacking, hind coxae bare above bases of femora, and the mesonotum with but two pairs of postsutural dorso-centrals." In the key to South American genera of Sciomyzidae (Steyskal and Knutson, 1975) we noted that the holotype, "... apparently is not in the British Museum (N.H.) and no other specimens are known to us." We placed *Pseudomelina* in that part of the key (couplet 8) which includes species lacking a propleural bristle.

In February 1976 I discovered the male holotype of *Pseudomelina apicalis* in the British Museum (Natural History). The specimen is labeled, "Type [red circle]," "Pseudomelina apicalis type det. J. R. Malloch," "Puerto Montt, 24.XII.1926," "S. Chile, Llanquihue prov., F. & M. Edwards, B. M. 1927-63." The propleural bristle is absent on either side, and there do not appear to be sockets where these bristles may have been present. Five females from the Canadian National Collection (CNC) compare exactly with the holotype and the description except that the CNC specimens each have a well-developed propleural bristle on each side. The species was adequately described by Malloch (1933). However, in the specimens from the CNC the number of pre-apical anterodorsal bristles on the hind femur, stated as two by Malloch, range from one to three.

The specimens that I have seen are labeled: CHILE, Aysen, Puerto Cisnes, 72 40'W 44 45'S, 16-28-II-1961, Peña (2♀, CNC; 1♀, USNM), same data, except 1-15-II-1961 (1♀, CNC). CHILE, Valdivia, Puerto Fin, 000 800 m, 4-III-1955, Peña, compared with type in B.M., det. L. Knutson, 1976 (1♀, CNC). Linares, Fundo Malcho, II-1958, Peña (1♀, CNC).

Sepedon relictus van der Wulp, 1897

Sepedon haplobasis Steyskal 1960, New Synonymy

Van der Wulp (1897) described *Sepedon relictus* on the basis of one "male" from Mexico City. Steyskal (1951) placed *S. relictus* as a synonym

of *S. praemiosa* Giglio-Tos, 1893. Fisher and Orth (1972), in comparing the type of *S. relictus* with “. . . a number of females of *S. praemiosa* taken at various localities from Oaxaca, Mexico to Colorado, U.S.A. . . .” noted that the type-specimen is a female and removed *S. relictus* as a synonym of *S. praemiosa*. They suggested that *S. haplobasis* Steyskal, 1960 is a synonym of *S. relictus*. In February, 1976, I compared a male paratype of *S. haplobasis* from the USNM labeled, “km. 15, Ruta 190, nr. Mexico City, Mex., 12.VIII.1958, S. E. Neff” “*Sepedon haplobasis* Steyskal, paratype” with the holotype female in the British Museum (N.H.), and I consider the specimens to represent one species. The holotype of *S. relictus* is labeled, “Type [red circle],” “♂,” “B.C.A. Dipt. II, *Sepedon relictus* v. d. W.,” [blank yellow label], “Mexico City, May 88, H. H. S.,” “CENT. AMERICA: F. D. Godman & O. Salvin, B. M. 1903-172.”

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NEW RECORDS OF CADDISFLIES (TRICHOPTERA) FOR OHIO

Eric P. McElravy, Thomas L. Arsuffi, and Benjamin A. Foote

Abstract.—Collections of adult Trichoptera were made along several streams in northeastern Ohio between 1970 and 1976. Sixty-nine of the collected species apparently represent new records for Ohio. An annotated list of the newly recorded species is presented and it nearly doubles the number of caddisflies reported from Ohio.

The order Trichoptera has been little studied in Ohio. Marshall's (1939) work on the caddisflies of western Lake Erie is apparently the only study dealing exclusively with the occurrence of species of the order in the state. Most of the other records for the state are given in Ross' (1944) work on the Illinois fauna. A few additional records are contained in Horwath's (1964) study of the insects of Gibraltar Island (western Lake Erie), Gordon's (1974) revision of *Cheumatopsyche*, and Ross' (1966) descriptions of new *Oecetis* species. As a result of these earlier published studies, 77 Trichoptera species were known to occur in Ohio. Forty-nine of these species are from Lake Erie. In addition, two more species of *Hydropsyche* are listed for the state by G. Schuster and D. Etnier, University of Tennessee, in their study of the immatures of that genus (personal communication). Resh (1975) reported 175 species from Kentucky; presumably a similar number will be recorded from Ohio.

Since 1970, and especially between 1974 and 1976, collections of Trichoptera have been made at four stream sites in northeastern Ohio (Fig. 1). Sixty-nine of the species apparently are the first reported records for the state. Complete lists are forthcoming for the collections from northeastern Ohio.

Description of Study Areas

Stebbins Gulch.—Stebbins Gulch, located within the Holden Arboretum in western Geauga County, is a deep gorge cut in sandstone and conglomerate. The stream that flows through this gorge, a tributary of the East Branch of the Chagrin River, has a high gradient and good water quality. Collections were made by sweeping during 1970, 1971, and 1972 (Tkac, 1973).

Cuyahoga River.—The Cuyahoga River in Portage and Geauga Counties is a moderately-sized stream of varying substrate and current. Collections of Trichoptera were made in 1975 with a gasoline lantern by J. Wilke, De-

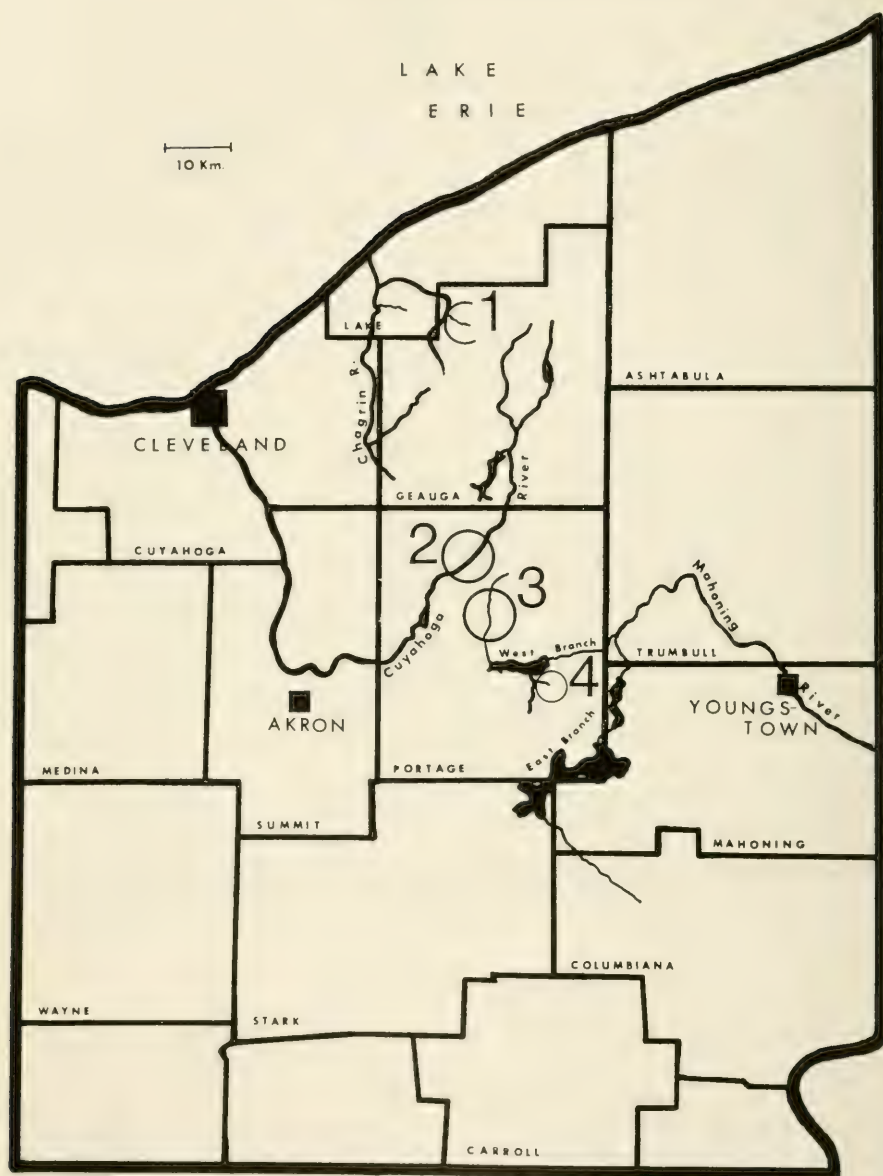


Fig. 1. Location of sampling sites in northeastern Ohio. 1, Stebbins Gulch. 2, Upper Cuyahoga River. 3, Upper West Branch, Mahoning River. 4, Tributary of Silver Creek.

partment of Biology, University of Akron, who is presently completing a study of the Trichoptera of the upper portion of this river.

West Branch, Mahoning River.—The upper portion of this river in Portage County is a small to moderately-sized stream (width 2–12 m) that has reasonably good water quality. Intensive collections were made with blacklight traps during 1974 and 1975 as part of a more comprehensive study of the caddisflies occurring in the area (McElravy, 1976).

Silver Creek Valley.—A small tributary which enters Silver Creek from the southeast just south of the West Branch Reservoir in Portage County is being studied by T. Arsuffi. Trichoptera collections were made with a blacklight trap during 1975 and 1976. The small woodland stream (width 2–3 m) flows over a substrate consisting primarily of sandstone and loose rubble.

Annotated List of Species

The list below presents collection data for those species that represent new records for Ohio. The following symbols are used to indicate collection sites: S—Stebbins Gulch; C—Cuyahoga River (upper portion); WB—West Branch, Mahoning River (upper portion); SC—Tributary of Silver Creek.

Rhyacophilidae

- Rhyacophila banksi* Ross. (S), June.
Rhyacophila carolina Banks. (S), June to September.
Rhyacophila carpenteri Milne. (S), August.
Rhyacophila glaberrima Ulmer. (S); July, August.
Rhyacophila torva Hagen. (S), June to September.
Rhyacophila vibox Milne. (S), June to August.

Glossosomatidae

- Glossosoma nigrior* (Banks). (S), (WB); April to September.
Protoptila lega Ross. (C); July, August.

Philopotamidae

- Dolophilodes distinctus* (Walker). (S), June to August.
Wormaldia shawnee (Ross). (WB); (SC); June, July.
Chimarra aterrima Hagen. (WB), (SC); May to August.

Hydroptilidae

- Oxyethira dualis* Morton. (C), July.
Oxyethira forcipata Mosely. (SC), June.
Hydroptila ajax Ross. (C); July, August.

- Hydroptila armata* Ross. (WB), May to August.
Hydroptila consimilis Morton. (C), (WB), (SC); May to September.
Hydroptila grandiosa Ross. (SC), May to July.
Hydroptila jackmanni Blickle. (WB), (SC); May to July.
Hydroptila perdita Morton. (C); (WB); July, August.
Hydroptila strepha Ross. (WB), August.
Hydroptila vala Ross. (WB), June.
Hydroptila virgata Ross. (SC), May.
Ochrotrichia arva (Ross). (WB); (SC); May, June.
Ochrotrichia spinosa (Ross). (WB), (SC); May to July.
Ochrotrichia wojcickyi Blickle. (WB), (SC); May to July. Reported only from Maine, our records represent a significant southwestward extension of its known range.
Mayatrichia ayama Mosely. (S), June.

Polycentropodidae

- Polycentropus centralis* Banks. (SC); May, June.
Polycentropus crassicornis Walker. (SC), May.
Polycentropus maculatus Banks. (S), June.
Polycentropus pentus Ross. (WB), (SC); May to August.
Polycentropus remotus Banks. (C), (WB); May to July.

Hydropsychidae

- Hydropsyche slossonae* Banks. (S), (C), (WB), (SC); May to August.
Hydropsyche sparna Ross. (WB), May to August.
Hydropsyche walkeri Betten and Mosely. (SC), May to September.
Cheumatopsyche aphanta Ross. (WB), (SC); May to August.
Cheumatopsyche halima Denning. (WB), May to September.
Cheumatopsyche miniscula (Banks). (SC), July.
Cheumatopsyche pasella Ross. (S), May to September.
Diplectrona modesta Banks. (S), (WB), (SC); May to August.

Phryganeidae

- Banksiola crotchii* Banks. (WB); (SC); June, July.
Banksiola dossuaria (Say). (WB); (SC); June, July.
Ptilostomis postica (Walker). (WB); June, September.

Molannidae

- Molanna blenda* Sibley. (WB), (SC); July.
Molanna tryphena Betten. (C), August.

Odontoceridae

Psilotreta indecisa (Walker). (WB); May, June.

Leptoceridae

Trienodes abus Milne. (WB); June, July.

Trienodes frontalis Banks. (SC), June.

Trienodes ignitus (Walker). (WB), (SC); June to September.

Trienodes marginatus Sibley. (WB), (SC); May to September.

Trienodes nox Ross. (WB); June, July.

Ceraclea alagma (Ross). (C); (WB); June, July.

Leptocerus americanus (Banks). (WB), June to August.

Nectopsyche diarina (Ross). (C), July.

Oecetis osteni Milne. (C), July.

Mystacides longicornis (Linnaeus). (C), July.

Goeridae

Goera stylata Ross. (S), (WB); May to July.

Limnephilidae

Ironoquia lyrata (Ross). (WB), (SC); August, September.

Ironoquia parvula (Banks). (WB), October.

Neophylax concinnus McLachlan. (WB); September, October.

Neophylax oligius Ross. (WB); September, October.

Limnephilus consocius Walker. (WB); June, September, October.

Limnephilus indivisus Walker. (WB); May, September, October.

Platycentropus radiatus (Say). (WB); June, July.

Hydatophylax argus (Harris). (WB); (SC); June, August.

Pycnopsyche divergens (Walker). (WB); May, September.

Pycnopsyche guttifer (Walker). (WB); September, October.

Pycnopsyche lepida (Hagen). (WB), August to October.

Pycnopsyche luculenta (Betten). (WB), September.

Pycnopsyche scabripennis (Rambur). (C), (WB), (SC); July to October.

Acknowledgments

We wish to thank Dr. O. S. Flint, Jr., Smithsonian Institution, and Dr. G. B. Wiggins, Royal Ontario Museum, for their assistance in identification of difficult specimens. We thank also J. Wilke and Dr. J. Olive of the University of Akron for permission to use data from their collections along the upper Cuyahoga River.

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STUDIES ON IDIOCERINAE LEAFHOPPERS, XIX: A NEW
GENUS FROM SURINAM, NORTHERN SOUTH AMERICA

J. Maldonado-Capriles

Abstract.—The new idiocerine genus and species *Nannicerus gracilis*, are described, illustrated, and compared with allied leafhopper taxa.

The new genus and species described below was found among material sent to me for study by Dr. J. P. Kramer, Systematic Entomology Laboratory, Agric. Res. Serv., USDA, c o U.S. National Museum, Washington, D.C.

The types are deposited in the USNM and in my collection (JMC). In the descriptions that follow, 13 micrometer units are equivalent to 1.0 mm.

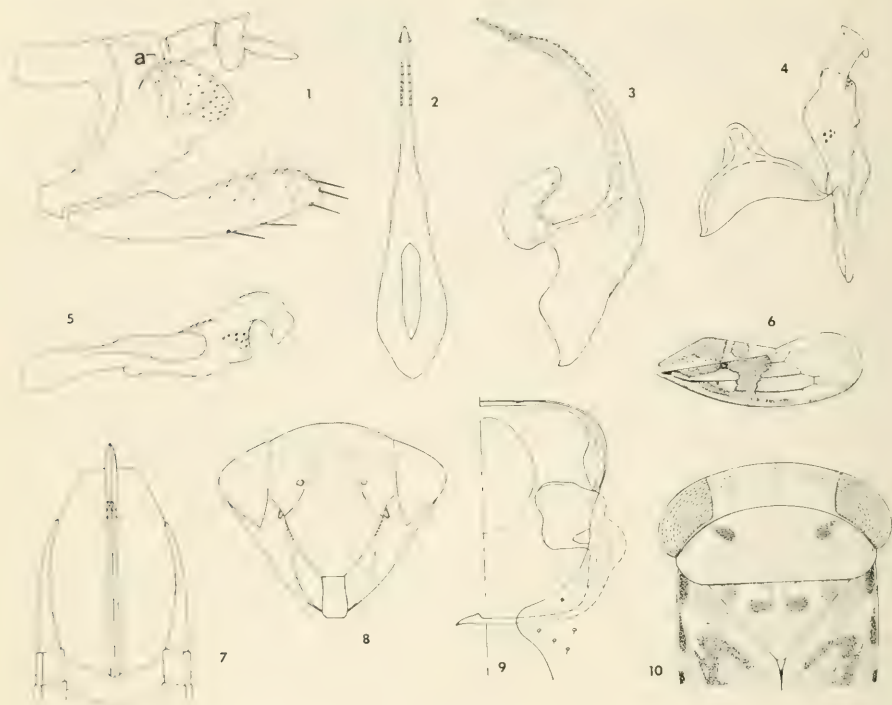
Nannicerus Maldonado-Capriles, new genus

Male.—Stramineous; basal $\frac{1}{2}$ of forewings conspicuously ornamented with reddish areas and with 1 or 2 black spots on base of clavus and corium. Ocelli apart at $3\times$ the distance from ocellus to eye. Pronotum slightly longer than vertex; scutellum about as long as pronotum. Forewing with 4 apical, no anteapical, and 1 costal cell. Inner-lower row (r_4) of spines of hind tibia consisting of spines of 2 different thicknesses. Pygofer subtriangular with a strong longitudinal fracture on upper margin; plates with fine setae on upper margin and a few strong setae on lower margin; 10th tergum with complex, hook-like appendix on lower basal angle; aedeagus with dorsal subapical double row of short peg-like spines.

Female.—Shape and coloration much as in male. Female genitalia as in Fig. 7; relatively broad across pygofers, with pair of fine hairs crossed over ovipositor.

Nannicerus gracilis Maldonado-Capriles, new species

Male.—Base coloration of head and thorax stramineous. Vertex with 3 round pale orange spots near anterior margin, vitreous area well developed (Fig. 10). Face (Fig. 8) with orange spots above and between ocelli; postclypeus, genae, anteclypeus, and lora mostly stramineous, apical $\frac{1}{2}$ of anteclypeus brownish, gena with narrow blackish area below antenna. Postclypeus with trace or with 2 well-developed rows of pale orange spots on disc. Scutellum as in Fig. 10; pale yellow, ornamented with dark brown. Forewing (Fig. 6) translucent; costal margin to apex of outer apical cell blackish; clavus and basal $\frac{1}{2}$ of corium irregularly ornamented with pink or reddish areas that are margined with red or violet, reddish



Figs. 1-10. *Nannicerus gracilis*. 1, genital capsule, male, lateral. 2, aedeagus, male, caudal. 3, aedeagus, male, lateral. 4, connective and style, dorsal. 5, style, male, lateral. 6, forewing, female. 7, genital capsule, female, ventral. 8, face, male, frontal. 9, detail of appendix of tenth tergum, male, caudal. 10, anterior half of body, male, dorsal.

areas sometimes of a moldy appearance; apical $\frac{1}{2}$ of corium without these areas, some cells smokey; clavus and/or corium basally with black oval areas in some specimens (Fig. 10); veins reddish, in some areas poorly defined. Legs stramineous or yellowish; apex and apical spines of metatibia light brown; tarsi yellowish. Abdominal sterna brownish with apical margin narrowly yellow. Genital capsule dark brown, margin of 7th sternum narrowly yellow.

Head: Vertex $4\times$ as wide as long (10:2.5), margins parallel; pronotum nearly $2.5\times$ as wide as long (16:7); hind margin nearly straight. Scutellum $1.5\times$ as wide as long (12:8); face wider across eyes than long (20:18); ocelli apart at nearly $3\times$ the distance from ocellus to eye (6:2). Lateral margin of postclypeus slightly curved; upper lateral suture not reaching ocellus of corresponding side, slightly arcuate. Anteclypeus $2\times$ as long as wide basally (5:2.5), sides concave. Metafemur with 2 apical spines;

spines of metatibia as follows: r_1 —30–35 hair-like; r_2 —14 fine; r_3 —5 stronger, from about midlength to apex; r_4 —first 5 or 6 as fine as those in r_2 and last 4 or 5 nearly as strong as those in r_3 .

Genitalia: Pygofer subtriangular, with strong longitudinal fracture above, uppermost margin with ventrally projected apodeme (a in Fig. 1); plates with fine setae on upper margin and 5 stronger setae on lower and apical margins. Tenth tergum as in Figs. 1 and 9; with complex hook-like appendix on lower basal angle. Style as in Figs. 4 and 5. Aedeagus (Figs. 2, 3) long, slender, curved cephalad; subapically with dorsal double row of small peg-like spines; gonopore opening dorsally near apex. Connective semicircular, flat (Fig. 4). Length 4.4 mm.

Female.—Coloration much as in male; row of spots on postclypeus well defined, light brown; black under antenna more extensive than in male. Spots of scutellum extending and fusing with each other or smaller than in male. Abdominal sterna lighter or darker than in male; genital capsule brown.

Head: Width across eyes 2.1; vertex as in male (11:2.5); pronotum as in male (18:7); scutellum as in male (13:9). Face slightly wider across eyes than long (21:19); ocelli very slightly closer to eyes than in male (2:6.5).

Genitalia: Genital capsule shorter than abdominal sterna together (20:27); across pygofers relatively broad (Fig. 7), each pygofer with a fine setae bent mesad over ovipositor; last abdominal sternum concave and with a small round notch medianly. Length 4.6 mm.

Holotype.—Male, BRITISH GUIANA. Demerara, 13 March 1913, in the USNM, Cat. No. 74019.

Allotype.—Female, same data, in the USNM. Paratypes 7 males and 4 females; one of each in JMC, others in USNM; all with same data as holotype.

The general shape of this new genus and species is somewhat similar to some of the small species erroneously described by Osborn (1923, 1924) as belonging to *Idiocerus*. I have studied the male genitalia of Osborn's types. Osborn's species can be separated into two groups, one including those species with no anteapicals and another including those with one or two anteapicals. *Nannicerus* differs from those in the first group and is characterized by the longitudinal fracture of the pygofer, the shape of the aedeagus, the arrangement and shape of spines on r_4 , and the setae of the plates. These characters also separate it from the other idiocerine genera.

Etymology.—*Nanni* means baby, and hence small, in Nepalese and is the nickname of my daughter Maria Teresa who was born in Nepal; *cerus*, meaning antenna, is an ending commonly used in the generic names of the idiocerines.

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NOTE

THE DATES OF WALKER.
INSECTA SAUNDERSIANA . . . DIPTERA

Walker's portion of *Insecta Saundersiana* . . . , the Diptera, was published in five continuous paged parts between 1850 and 1856. These parts have been traditionally dated as follows: Pt. I, pp. [i], 1-76, pls. 1-2, 1850; Pt. II, pp. 77-156, pls. III-IV, 1851; Pt. III, pp. 157-252, pls. V-VI & Pt. IV, pp. 253-414, pls. VII-VIII, 1852; and Pt. V, pp. [ii], 415-474, 1856. (Horn & Schenkling, 1929. Index Literature Entomol. ser. I, p. 1284; 1913. Cat. Books Brit. Mus. (Nat. Hist.), 4:1811; and Stone et al., 1965. Catalogue of Diptera of America North of Mexico, USDA Agric. Hdbk. 276. Pp. 1461-1462). The source for this dating is not given but probably stems from Hagen (1863. Bibliotheca Entomol. 2:254). Hagen gave dates for all parts except Part IV and this is the part which has been incorrectly dated as 1852, the same date as Part III. Most copies of this book have been bound without the covers (wrappers) with which each part was issued. I have recently acquired a copy with the covers bound-in. The cover for Part IV is dated 1853, a date which is also on plates VII-VIII. This change in publication date, while affecting the dates for about 300 species, will probably not affect the stability of nomenclature because no other major works on exotic Diptera were published in 1852-1853.

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BIOLOGY OF *OIDEMATOPS FERRUGINEUS*
(DIPTERA: SCIOMYZIDAE), A PARASITOID ENEMY OF
THE LAND SNAIL *STENOTREMA HIRSUTUM*
(MOLLUSCA: POLYGYRIDAE)

B. A. Foote

Abstract.—The biology of *Oidematops ferrugineus* Cresson and its association with the common woodland snail *Stenotrema hirsutum* (Say) is discussed.

The acalyptrate dipterous family Sciomyzidae consists of approximately 600 species distributed in nearly all of the world's faunal regions. Over 150 species have been recorded from North America. Thanks to the long-continued efforts of C. O. Berg and a host of his students at Cornell University, the basic biology of the family is now quite well known. The larvae are predators or parasitoids of snails, snail eggs, slugs, and finger-nail clams (Berg and Knutson, 1978). Because of their predaceous habits, several of the aquatic species may have value in the biological control of medically or agriculturally important snails (Berg, 1973; Chock et al., 1961; Pettijean, 1966).

Most Sciomyzidae have aquatic or subaquatic larvae and are commonly abundant in wetland habitats. In contrast, surprisingly few of the Nearctic species occur in truly terrestrial environments. Adults of these species, about 12 in number, are usually encountered in mesic woodlands where their larvae prey on land snails (Bratt et al., 1969; Foote, 1961) or slugs (Trelka and Foote, 1970). A somewhat smaller number of species are found in marshy habitats but have larvae that prey on terrestrial pulmonate gastropods, particularly succineid snails (Berg, 1953; Bratt et al., 1969; Foote, 1959b, 1961). A distinct trend towards increasingly intimate associations with the molluscan prey is correlated with the ecological shift from aquatic to terrestrial habitats (Berg et al., 1959).

During the spring of 1966, puparia of an unrecognized species of Sciomyzidae were discovered in empty shells of the common woodland snail *Stenotrema hirsutum* (Say) (Polygyridae). Adults reared from these puparia proved to be *Oidematops ferrugineus* Cresson, a very rare and biologically unknown species. During subsequent rearings, the life cycle and larval feeding habits have been elucidated. Discovery of the larvae of *Oidematops* fills in the last remaining gap in our biological knowledge of genera of the tribe Sciomyzini in North America.

Other genera of Sciomyzini for which life history data are available are *Atrichomelina* (Foote et al., 1960), *Colobaea* (Knutson and Bratt, in prepara-

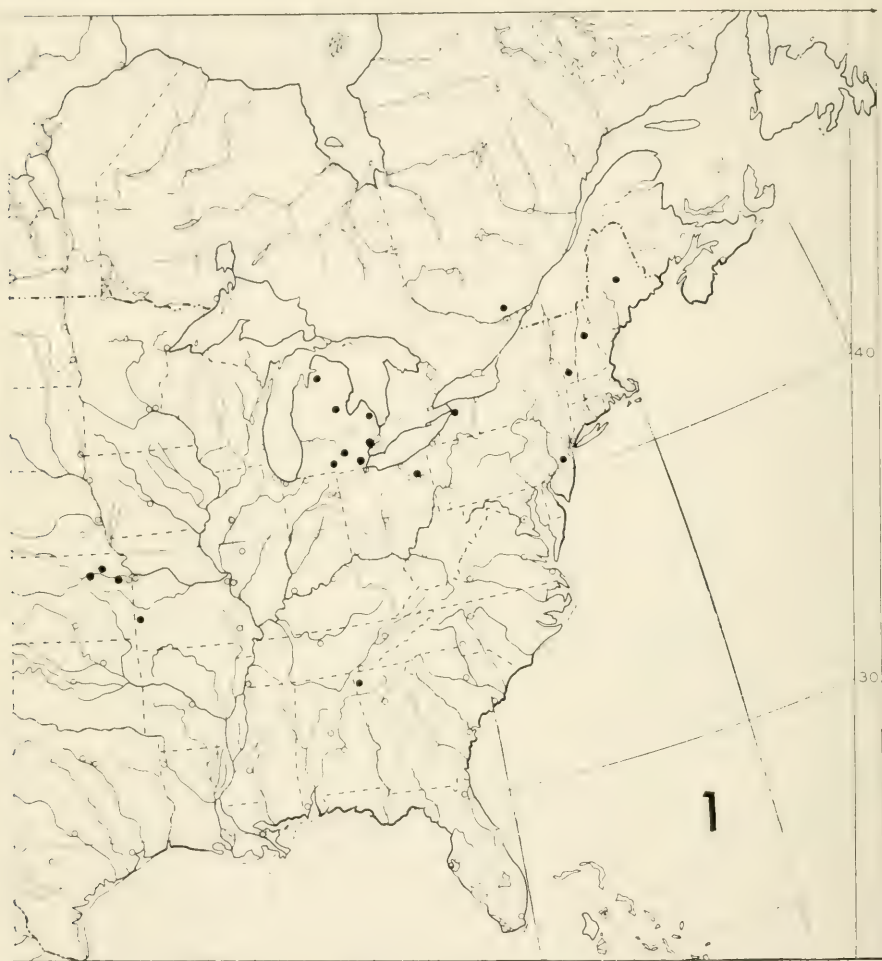


Fig. 1. Distribution of *Oidematops ferrugineus*.

tion), *Pherbellia* (Berg, 1953; Bratt et al., 1969; Foote, 1973), *Pteromicra* (Rozkošný and Knutson, 1970), and *Sciomyza* (Berg, 1953; Foote, 1959a). Of the 20 recognized genera of Nearctic Sciomyzidae, only *Dictyacium* and *Poecilographa*, both members of the tribe Tetanocerini, remain unknown biologically.

The strictly Nearctic genus *Oidematops* was originally proposed by Cresson (1920) for his new species, *ferrugineus*, the type-specimen of which was collected by C. W. Johnson at Manchester, Vermont in 1910. The genus has remained monotypic until the present time. It belongs to the tribe Sciomyzini of the subfamily Sciomyzinae (Steyskal, 1965) and probably

is relatively close phylogenetically to the genus *Sciomyza*. It is distinguished from other genera of Sciomyzidae by the following combination of characters: Propleural bristle well developed, fore tibia with 2 pre-apical bristles, arista white, 1 orbital bristle, post humeral bristle absent.

Adults of *Oidematops ferrugineus* are shining reddish brown in color; range in length from 6.5 to 8.5 mm; have slightly darkened, unpatterned wings; a distinctly protruding facial region; and a white arista.

The distribution of *O. ferrugineus* (Fig. 1) is eastern and midwestern, with records available for Georgia, Kansas, Maine, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Vermont and Quebec. The range of the fly corresponds fairly well with that of the host snail, *Stenotrema hirsutum*, which occurs from eastern Canada to Georgia and west to Minnesota, Kansas, and Mississippi (Burch, 1962; LaRocque, 1953).

The present paper includes information on the life cycle and larval feeding habits of *Oidematops ferrugineus* and discusses the ecological relationship of this taxon to other North American Sciomyzidae that attack terrestrial gastropods.

Life History

In northeastern Ohio, *O. ferrugineus* was found only in lowland deciduous woods dominated by such tree species as American elm (*Ulmus americana* L.), silver maple (*Acer saccharinum* L.), and black cherry (*Prunus serotina* Ehrhart). Herbaceous vegetation present in the area during late May was somewhat hydrophilic and dominated by skunk cabbage (*Symplocarpus foetidus* (L.) Nuttall). A few small vernal pools were present, although *Stenotrema* snails harboring overwintering puparia were rarely, if ever, found in the wetter sites. According to Baker (1939), *Stenotrema hirsutum* "is one of the commonest and widely distributed snails in Illinois. Its usual habitat is in forests along river valleys where there is a growth of oak, hickory, elm, basswood, and box elder trees. The snail is found under and in old logs and under forest debris It seems to prefer moist locations, but has been found in some places which are relatively dry." Leonard (1959) states that "*Stenotrema hirsutum* is a characteristic snail of humid, forested regions." Other species of Sciomyzidae collected in the habitat were *Poecilographa decora* (Loew), *Euthycera arcuata* (Loew), and *Tetanocera rotundicornis* Loew.

Judging from the few collection records available, the adult flight period extends from late May to early July. Adults were not encountered in nature in northeastern Ohio, but rearing records indicate that the flight period is about one month. Emergence occurs in late May, and mating and oviposition take place during the first two weeks of June. Two females that emerged from overwintering pupae collected in nature lived

in the laboratory for 25 and 26 days, respectively. The premating period for these two females was two and three days. No overt courtship behavior was observed, and mating attempts seemed to be of the assault type. The mating position resembled that described for many other species of the tribe Sciomyzini (Bratt et al., 1969). The copulatory act lasted from less than 20 minutes to well over an hour.

The preoviposition period, from emergence of a female to her first egg-laying activity, varied from 3–5 days. Nearly mature eggs were present in the ovaries of newly emerged females. That unfertilized females will oviposit is shown by the fact that an unmated female that emerged on 20 March 1966, deposited 84 inviable eggs before dying on 10 April. Mated females were more fecund, and three females that emerged in late April and early May produced 194, 272, and 322 eggs, respectively. The oviposition period for these three females ranged from 8–22 days and the daily egg production for a female varied from 0–56. The female that lived only 8 days averaged 24.2 eggs day, the one living 20 days produced an average of 16.1 eggs day, and the female that lived 22 days averaged 12.4 eggs day. There was no noticeable decline in the number of eggs laid per day as the three females aged. Thus, one female deposited 32 eggs, another produced 27, and the third laid 25 eggs during the day preceding death. Eggs were attached to various sites in the breeding jar, although most were placed on projecting sprigs of the peat moss that formed a moist substrate in the jars. Of the 788 eggs deposited by the three fertilized females, approximately 750 were placed on the peat moss. The remaining eggs were placed singly or in groups of 2–5 onto shell fragments of dead *Stenotrema* snails, the glass walls of the breeding jars, and the cheesecloth covers. No eggs were placed on the shells of living *Stenotrema*. Eggs were not arranged in distinct clusters and were not affixed to the substrate by a mucilaginous secretion. They were easily removed by use of a moistened brush. The eggs possessed no unusual features in the chorionic markings and resembled quite closely eggs of numerous species of *Pherbellia*. The incubation period varied from 4–14 days and averaged 6 days.

Newly hatched larvae were quite active and moved steadily, if erratically, over the substrate. They paused frequently and changed direction repeatedly but, in contrast to the slug-killing larvae of *Tetanocera plebeia* Loew (Trelka and Foote, 1970), rarely lifted the anterior part of the body away from the substrate. They did not show a tendency to crawl up vertical surfaces but did avoid drier areas in the rearing dishes, and they moved away from areas illuminated by a microscope lamp. No burrowing habits were noted, and larvae generally remained on the surface of the peat moss substrate as long as moisture was present.

Upon contacting an active or retracted snail, the larva paused and applied its anterior end to the edges of the snail's foot or mantle. If the

snail was *Stenotrema hirsutum*, the larva quickly crawled into the aperture of the shell and attempted to insert itself between the flesh and the columella. Larvae that encountered snails other than *S. hirsutum* did not attempt to move into the aperture and quickly resumed their wandering movements over the moist substrate. Larvae failed to invade *Catinella avara* (Say), *Oxyloma* sp. (Succineidae), *Ventridens demissus* (Binney) (Zonitidae), *Haplotrema concavum* (Say) (Haplotrematidae), and *Triodopsis multilineata* (Say) and various other unidentified immature individuals of the family Polygyridae, all species that occurred in the larval habitat. They also failed to attack *Arion* and *Deroceras* slugs and showed no interest in gastropod eggs. Larvae that successfully invaded *Stenotrema* always assumed a position between the flesh of the snail and the shell, although many larvae shifted their locations frequently. Larvae usually positioned themselves so that their posterior spiracles were exposed to air in the aperture of the shell, although a few larvae moved deeper into the shell and thus lost contact with the aperture. Most of the latter larvae failed to survive beyond the first instar and could be found several days later as dead individuals flattened against the shell. Multiple attacks by newly hatched larvae were common, and as many as four larvae were found in a partly retracted snail. None or only one of the multiple larvae survived to form puparia, and very few managed to reach the second instar. Successful development to the pupal stage even by singly infesting larvae was rare. Although approximately 150 living *Stenotrema* were attacked by newly hatched larvae in the laboratory rearings, only 19 puparia were obtained. This is a success rate of 13%. Mortality was highest among first-stage larvae, either because they failed to invade a *Stenotrema* or because they were unable to maintain themselves in the snail. Several of the latter apparently were forced to leave the snail because they were one of 2-4 larvae that had originally infested the host. Practically none of these larvae managed to invade a second snail. Other larvae died in the second or third instar mostly because of the premature death of the snail. Larvae that survived until at least halfway through the third stadium in a living host could withstand death of the snail and complete larval life as scavengers, feeding on the decomposing snail tissues. In contrast, younger larvae quickly succumbed once their host expired. Strangely, most of these larvae made no attempt to abandon the dying or dead snails but instead remained within the liquifying tissues. These larvae usually died within 1 or 2 days following death of the host. Many first instars, even if they were the sole invaders of a *Stenotrema*, failed to retain their position within the snail and could be found a few days later entrapped in a ball of mucus lying on the substrate. Perhaps the mortality rate of larvae reared under laboratory conditions was higher than that of larvae hatching under natural conditions due to the greater activity of the snails that were held under constantly humid conditions. *Stenotrema* snails in nature

probably are relatively inactive during the daylight hours, thus allowing easier entrance and establishment of newly hatched larvae. However, an argument against the idea of a higher mortality rate in laboratory-reared larvae is the fact that only 10 puparia were found in 150 *Stenotrema* snails collected in nature on 23 March 1966. This is an infestation rate of 6.6%, a figure distinctly below the 13% success rate obtained in the laboratory rearings.

Larvae fed by scraping the flesh of the snail with their sharply pointed mouthhooks. The mouthhooks apparently worked in conjunction with the anteriorly toothed ventral arch, located below the mouthhooks, to rip and tear pieces of flesh from the snail's mantle. Later, the foot and internal organs were attacked and consumed. Destruction of the latter, of course, quickly caused death of the host. Snails containing only one larva usually remained alive and active for at least 6 days after being invaded by a newly hatched larva. They moved about the rearing dish, fed on provided lettuce, and seemingly were unaffected by the feeding of the slowly developing larva. However, 6–10 days after being initially attacked, the snails retracted into their shells and no longer crawled about the rearing dishes. A day or so later, they showed distress by exuding a milky mucus and developing waves of fine tremblings that passed over the surface of the retracted foot. The larva at this time was always in the second or third instar. Infested snails typically died 4 or 5 days after becoming retracted, at which time the larva was in the third instar and quite sizeable. Between 12 and 16 days commonly elapsed from the original larval invasion to death of the snail host.

After death of the host, the third instar fed as a scavenger on the decomposing, rapidly liquifying snail tissues. It always kept its posterior end at the surface of the black, evil-smelling carcass and accompanying fluids with the result that the spiracles were in constant contact with air. Shortly before forming its puparium, each larva tended to clean the shell of remaining flesh by actively shoving the decomposed remains out of the shell aperture. The larva then reversed its position and formed a puparium in the body whorl of the shell. The anterior end of the puparium usually was located just behind the teeth that project from the wall of the body whorl into the lumen of the shell.

Although it was difficult to get accurate data on the duration of the 3 larval stadia, I estimate that the first stadium lasted about 4–5 days; the second, 6–8; and the third, between 10 and 12 days. The total larval period ranged from 20–25 days.

The prepupal period, from formation of the puparium to actual appearance of the pupa, ranged from slightly less than 24 hours to somewhat over 48 hours. Apparently growth and development quickly ceased in the newly-formed pupae, as none even developed eye pigment during the

several weeks that they were held at room temperatures. They entered a state of diapause that was broken only by exposing pupae to extended periods of low temperature.

Nineteen puparia containing apparently viable pupae were obtained in the laboratory rearings. No adults had emerged from these puparia after continuous exposure to room temperatures for periods varying from 26 (1 puparium) to 106 days (2 puparia). All puparia, still with apparently viable pupae, were subsequently placed in an unlighted refrigerator where they were held at 5–7°C for periods varying from 90–150 days. They were then returned to room temperatures. No emergence from these chilled puparia was obtained, an indication that the pupal diapause is quite intense.

In contrast to the failure of laboratory-reared pupae to break diapause, a puparium collected in nature on 14 September 1965, finally produced an adult female on 20 March 1966. The puparium had been placed in a dark refrigerator on 20 October 1975, where it remained until 1 March 1976, a lapse of 165 days. This rearing suggests that longer exposures to low temperatures than the 90–150 days given the laboratory-reared individuals is necessary to break diapause. Six of eight puparia collected in nature on 23 March 1966 produced adults in the laboratory within 31 days.

That a few pupae in each generation require at least two lengthy exposures to low temperatures before they will break diapause is suggested by the fact that two of the eight puparia collected on 23 March had not produced adults by 8 September 1966, after 169 days of continuous exposure to room temperatures. Both still contained apparently viable pupae at the end of the holding period.

All of the rearing records strongly suggest that *Oidematops ferrugineus* is univoltine. Adults emerge in late May and June, quickly mate, and begin ovipositing within 3–5 days. The incubation period is 4–14 days, and the larval period lasts approximately 22 days. Pupae are formed in early and midsummer; these quickly go into diapause and serve as the overwintering stage. Diapause appears to be obligatory and is broken by exposure to low winter temperatures. A few pupae in each generation may require at least two exposures to winter temperatures before renewing development and producing adults.

Apparently pupae of *O. ferrugineus* are occasionally destroyed by parasitoid wasp larvae, as a small emergence hole was found in a puparium collected in nature on 14 September 1965.

Ecological Relationship of *Oidematops ferrugineus* to Other Sciomyzidae that Attack Terrestrial Gastropoda

Table 1 lists the 22 species of Sciomyzidae that are known to prey on terrestrial Gastropoda in North America. Only records of gastropod genera

actually known to harbor larvae in nature are included; laboratory rearings utilizing other genera are deleted. The following discussion is restricted to woodland inhabiting species that could be potential competitors of *O. ferrugineus* for a possibly limited supply of land snails. Other species included in Table 1 either occur beyond the range of *O. ferrugineus* or are found in open marshes and thus are segregated by habitat.

Sciomyza aristalis Coquillett and *Tetanocera melanostigma* Steyskal are fairly common in lowland woods in the eastern states but are in a trophic niche distinctly different from that occupied by *Oidematops ferrugineus*. Both species are specialized parasitoids of snails belonging to the family Succineidae. Their larvae are highly host specific and have never been found in nature in any gastropod genera except *Succinea* and *Oxyloma*.

Pherbellia albocostata (Fallén) and *Pteromicra steyskali* Foote have been reared from species of *Discus*, a genus of the family Endodontidae. Thus these species also are utilizing a family of land snails different than that attacked by *Oidematops ferrugineus*.

Pherbellia albovaria (Coquillett) has been reared from a species of *Triodopsis*, a member of the Polygyridae, the same family to which *Stenotrema hirsutum*, the host of *Oidematops ferrugineus*, belongs. Although larvae of *Pherbellia albovaria* have not yet been found in *Stenotrema* it is reasonable to assume that this species occasionally could be in the same trophic niche as *Oidematops ferrugineus*. However, *Pherbellia albovaria* usually has been collected in mesic woodlands and has rarely been taken in the low, wetter forests favored by *Oidematops ferrugineus*. The two species are largely segregated by habitat, with the result that larval competition for a possibly limited snail resource is avoided or at least reduced.

Young larvae of *Tetanocera clara* Loew, *T. plebeia*, and *T. valida* Loew are restricted to slugs and thus would not be competing with *Oidematops* larvae for *Stenotrema* snails. However, older larvae of *Tetanocera plebeia* and *T. valida* are somewhat more generalized in their feeding habits and will attack *Stenotrema* under laboratory conditions. Possibly larvae of these two species at times utilize the same prey attacked by *Oidematops ferrugineus*.

The only sciomyzid that appears to be significant as a potential competitor of *O. ferrugineus* is *Euthycera arcuata*, a fairly common and widespread woodland-inhabiting species, whose larvae have been found in three genera of land snails, including *Stenotrema*. However, the two species appear to be somewhat temporally separated. *Euthycera arcuata* overwinters as a larva, whereas *Oidematops ferrugineus* passes the cold season as a pupa. *Oidematops* emerges as an adult in late May and early June, lays eggs within a few days, and completes larval development about a month later. In contrast, adults of *Euthycera arcuata* have not been collected in northeastern Ohio until late June and do not oviposit until

Table 1. North American species of Sciomyzidae known to prey on terrestrial gastropoda.

Species of Sciomyzidae	Genus of prey	Reference
Tribe Sciomyzini		
<i>Sciomyza aristalis</i> Coquillett	<i>Succinea</i>	Foote (1959a)
<i>Sciomyza dryomyzina</i> Zetterstedt	<i>Oxyloma</i>	Berg (1953), Foote (1959a)
<i>Sciomyza simplex</i> Fallén	<i>Oxyloma</i>	Foote (1959a)
<i>Oideumatops ferrugineus</i> Cresson	<i>Stenotrema</i>	Present paper
<i>Pherbellia albocostata</i> (Fallén)	<i>Discus</i>	Bratt et al. (1969)
<i>Pherbellia albovaria</i> (Coquillett)	<i>Discus, Anguispira, Zonitoides, Triodopsis</i>	Bratt et al. (1969)
<i>Pherbellia schoenherri maculata</i> (Cresson)	<i>Succinea, Oxyloma, Catinella</i>	Bratt et al. (1969)
<i>Pteromicra anopla</i> Steyskal	<i>Succinea</i>	Steyskal (1954)
<i>Pteromicra perissa</i> Steyskal	<i>Pupilla</i>	Steyskal (1958)
<i>Pteromicra steyskali</i> Foote	<i>Discus</i>	Foote (1959b)
Tribe Tetanocerini		
<i>Euthycera arcuata</i> Loew	<i>Mesodon, Stenotrema, Ventridens</i>	Foote (unpublished rearings)
<i>Hoplodictya acuticornis</i> (Wulp)	<i>Succinea</i>	Fisher and Orth (1972)
<i>Hoplodictya spinicornis</i> (Loew)	<i>Oxyloma, Succinea</i>	Neff and Berg (1962)
<i>Tetanocera clara</i> Loew	<i>Pallifera, Philomycus</i>	Trelka and Foote (1970)
<i>Tetanocera melanostigma</i> Steyskal	<i>Succinea, Oxyloma</i>	Foote (1961)
<i>Tetanocera oxia</i> Steyskal	<i>Catinella</i>	Foote (unpublished rearings)
<i>Tetanocera phyllophora</i> Melander	<i>Discus</i>	Foote (unpublished rearings)
<i>Tetanocera plebeia</i> Loew	<i>Deroceras, Oxyloma</i>	Trelka and Foote (1970)
<i>Tetanocera rotundicornis</i> Loew	<i>Oxyloma</i>	Berg (1953), Foote (1961)
<i>Tetanocera spirifera</i> Melander	<i>Oxyloma</i>	Foote (unpublished rearings)
<i>Tetanocera valida</i> Loew	<i>Deroceras</i>	Trelka and Foote (1970)
<i>Trypetaoptera canadensis</i>	<i>Vallonia</i>	Foote (unpublished rearings)

several days later. As a result, its larvae do not even begin searching for prey snails until sometime in July, at a time when larvae of *Oidematops ferrugineus* are reaching maturity and beginning to form puparia. Therefore, it is very doubtful if these two species, although occupying the same trophic and spatial niches, are actively competing for the same snail resource. Larvae of *Euthycera arcuata* probably attack only those individuals of *Stenotrema* that are missed by larvae of *Oidematops*. Further, *Euthycera* is more of a trophic generalist than *Oidematops* in that its larvae can attack a wider spectrum of terrestrial gastropods. Thus, only part of its larval population utilizes *Stenotrema* snails, considerably reducing the impact of this species on the highly host specific *Oidematops*.

It is quite possible that additional families of cyclorrhaphous Diptera contain species that prey on *Stenotrema* and thus trophically at least are ecological equivalents of *O. ferrugineus*. Very little work has been directed towards these other malacophagous species, but it is known that a few species of *Sarcophaga* (Sarcophagidae) have larvae that prey on land snails belonging to the family Polygyridae (Dodge, 1956). So far, however, none has been reared from any species of *Stenotrema*.

Based on the evidence available, it appears that *Oidematops ferrugineus* has invaded a niche that is relatively unoccupied by other species of Diptera. Of course, its high degree of host specificity has both advantages and disadvantages. By specializing on land snails of the genus *Stenotrema*, *Oidematops* has evaded competition from other malacophagous species. On the other hand, its trophic inflexibility makes it vulnerable to any environmental disruption that might reduce populations of its larval host.

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DIVERSITY OF TABANID FAUNA IN TWO MARYLAND
COUNTIES (DIPTERA: TABANIDAE)¹

William E. Bickley

Abstract.—The relative abundance of common tabanid species are reported and discussed for Prince George's and St. Mary's counties, Maryland.

Uebel and Bickley (1976) reported on weekly collections of tabanids at three sites in Prince George's County, Maryland in 1973, and Lawrence et al. (1976) reported on weekly or twice-weekly collections at three sites in St. Mary's County in 1975. The same traps were used, but the number of collections, particularly overhead net collections, differed. Nevertheless the two studies are comparable in many ways, and a subjective estimate of the relative abundance of the various species of flies contributes to an understanding of the nature of the fly problem affecting man and animals. In both studies it was noted that just a few miles can make a vast difference in the fauna, both qualitatively and quantitatively.

Uebel and Bickley (1976) recorded 13 species or subspecies from Prince George's County but which are presently not known to occur in St. Mary's County. Lawrence et al. (1976) recorded 7 species and subspecies from St. Mary's County but which are not known to occur in Prince George's County.

In Prince George's County the most productive site was the Hayden Farm, part of the Beltsville Agricultural Research Center. This area is between 3 and 4 mi from the Patuxent River, and here there are no brackish marshes. Two other Prince George's sites are contiguous with the Patuxent River about 25 mi south. Marsh areas here are tidal but only very slightly brackish.

In St. Mary's County one collecting site is on a farm with a freshwater pond and some swampy areas. The two other sites are near fresh water swamps and brackish marshes. These areas are approximately 40 mi south of the southernmost Prince George's County location.

Table 1 shows that there were five species considered abundant in both counties. Six other species considered abundant in Prince George's County were also taken in St. Mary's County. Of the other six abundant St. Mary's County species, three were also taken in Prince George's County. One species, *Tabanus nigrovittatus* Macquart was collected in 1972 at Magruder's Landing, Prince George's County (Bickley and Seek, 1975). However, two species, *Chrysops brunneus* Hine and *C. hinei* Daecke are not known to occur in Prince George's County. The data presented in Table 1 suggest that *Tabanus quinquevittatus* Wiedemann is very well adapted to several different environments, and the same holds true for *Chrysops vittatus*

Table 1. Relative abundance of common tabanid species reported in two Maryland counties; ranking from 1-11 with the most abundant species as 1.

	Prince George's County 1973	St. Mary's County 1975
<i>Chrysops</i>		
<i>brunneus</i> Hine		6
<i>dacne</i> Philip	9	
<i>flavidus</i> Wiedemann		5
<i>hinei</i> Daecke		8
<i>macquarti</i> Philip		7
<i>montanus</i> Osten Sacken	11	
<i>obsoletus obsoletus</i> Wiedemann	4	
<i>univittatus</i> Macquart		10
<i>vittatus</i> Wiedemann	5	3
<i>Hybomitra</i>		
<i>lasiophthalma</i> (Macquart)	1	11
<i>Tabanus</i>		
<i>lineola</i> F.	3	9
<i>nigripes</i> Wiedemann	8	
<i>nigrovittatus</i> Macquart		2
<i>pumilis</i> Macquart	7	
<i>quinquevittatus</i> Wiedemann	2	1
<i>subsimilis subsimilis</i> Bellardi	6	
<i>sulcifrons</i> Macquart	10	4

Wiedemann. On the other hand, species such as *C. brunneus* and *C. hinei* seem to have more precise ecological requirements that limit their distribution. An understanding of larval habitats and activities is prerequisite to the management of these important pests. The acquisition of needed information presents a formidable challenge.

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Footnote

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VERRALLIA VIRGINICA (DIPTERA: PIPUNCULIDAE)
REARED FROM THE SARATOGA SPITTLEBUG IN MAINE

J. P. Linnane and E. A. Osgood

Abstract.—A pipunculid parasite *Verrallia virginica* Banks is reared for the first time from the Saratoga spittlebug, *Aphrophora saratogensis* (Fitch). The rearing method is described and biological notes on the parasite are given.

The Saratoga spittlebug, *Aphrophora saratogensis* (Fitch), is a serious pest in young red pine, *Pinus resinosa* Aiton, plantations in the Lake States, Ontario, and more recently in the Northeast. Adults of this cercopid feed on the needle bearing twigs of their pine hosts. Nymphs of this spittlebug are found in or just below the litter surface, feeding on the stems of various herbaceous and woody plants comprising the understory vegetation in pine plantations (Anderson, 1947a; Ewan, 1961).

Anderson (1947b) reported the occurrence of a dipterous parasite attacking Saratoga spittlebug adults. Ewan (1961) found a pipunculid parasite attacking Saratoga spittlebug adults in Wisconsin. Parasitism rates in one plantation exceeded 60%, however, the parasite became effective too late to protect the plantation from spittlebug damage.

In 1974, dissections of adult Saratoga spittlebugs from eastern Maine revealed parasitic larvae of a pipunculid. During 1975, a rearing technique was developed to determine its identity.

Methods

Adult Saratoga spittlebugs were collected in several infested red pine plantations on various dates during July and August. The spittlebugs were preserved in alcoholic Bouin's solution, removed to alcohol and dissected to determine the presence of parasites. Development of the larvae was followed during the summer through dissections. When the parasitic larvae reached maturity, collections of spittlebugs were placed in gallon glass jars containing a substrate of a moist, sand-sawdust mixture. Emerging larvae formed puparia in the substrate. Puparia were then placed in vials and removed to containers with relative humidities ranging from 75 to 92%. After 10 days at room temperature (21 C), they were subjected to a cold period (3-5 C) for 75 days. Puparia were then removed to room temperature.

Results and Discussion

The first adults emerged 45 days after termination of the cold period. Ninety-two percent of the larvae treated as outlined above were successfully reared to the adult stage. Reared adults were identified as *Verrallia*

virginica Banks¹ (Thompson, 1977). Apparently this pipunculid parasitized the teneral adult of the Saratoga spittlebug about the second week of July. Larvae were first detected through dissection on July 30. Approximately 25 days later, parasitic larvae emerged and formed puparia. Larval developmental time was estimated as six to seven weeks. *Verrallia virginica* overwinters as a pupa and apparently emerges in late June or early July coinciding with the appearance of Saratoga spittlebug adults. From a limited sample, females were more heavily parasitized than males ($\chi^2 = 4.84$, $P < 0.05$). During 1975, parasitism rates never exceeded 8%.

Verrallia virginica is a former synonym of and similar to *V. aucta* (Fallén) which has been reared from *Philaenus spumarius* (Linnaeus) and *Neophilaenus lineatus* (L.) in England (Whittaker, 1969). There is no record of *Verrallia aucta* parasitizing either of these species in North America. Whittaker (1969) briefly described the biology of *V. aucta* in England. Eggs were inserted into the abdomen of teneral adult spittlebugs. There were probably two larval instars with a developmental time of 10–11 weeks. Mature second instar larvae occupied nearly the entire abdomen and reproductive organs were noticeably atrophied. Emerging larvae formed brick red puparia in which they overwintered. Adults emerged in June or July, synchronous with the appearance of their adult hosts.

Differences between the studies of Whittaker (1969) concerning *V. aucta* and our own on *V. virginica* should be noted (see Thompson, 1977). *Verrallia virginica* attacks a different genus of cercopid which occurs on a greatly different host plant. Considerable differences in the length of the larval developmental period and geographic range might also be significant.

A second type of larva was dissected from Saratoga spittlebug adults on two occasions. This presumably is another species of parasite, but no determination could be made as to its identity.

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Footnote

¹Determined by F. C. Thompson, Systematic Entomology Laboratory, Agric. Res. Serv., USDA, c/o U.S. National Museum, Washington, D.C. 20560.

NOTE

VERRALLIA VIRGINICA BANKS, A VALID SPECIES
(DIPTERA: PIPUNCULIDAE)

When I was sent *Verrallia* material by Linnane and Osgood (1977, Proc. Entomol. Soc. Wash. 79:622-623), I identified it as *aucta* Fallén, as that was then the only known species of *Verrallia* (sensu stricto). Hardy (1943, Univ. Kans. Sci. Bull. 29(1):27-29) considered *virginica* Banks (1915, Psyche. 22: 169) as a synonym of *aucta* and *csikii* Aczel (1940, Zool. Anzeiger. 132:152) (new name for *opacus* Williston (1886, Trans. Amer. Entomol. Soc. 13:295)) as a *nomen dubium*. However, the host and life history data subsequently supplied to me by Linnane and Osgood (Ibid.) were quite different from that previously reported for *aucta*. This discrepancy led me to compare carefully a male and female of *aucta* Fallén from England with Nearctic material of "*aucta*." While the male and female genitalia appear to be the same in both populations, a number of discrete color differences were noted. The correlation of the host and life history data with the color characters noted below convinces me that *aucta* of authors consist of two species: *aucta* Fallén, a Palearctic species, and a Nearctic species. Williston's description of *csikii* (as *opacus*; the type is lost) does not agree well with this Nearctic species, but the holotype of *virginica* Banks does. All the Nearctic material I have seen determined as *aucta* is *virginica*. Whether the true *aucta* of Fallén occurs in the Nearctic Region is not known, but its hosts *Philaenus spumarius* (L.) and *Neophilaenus lineatus* (L.) do occur here. I have examined 43 specimens of *virginica* from the following localities: USA: Maine (Washington Co.), Michigan (Grand Traverse Co.) and Virginia (Arlington Co.); and CANADA: Quebec, Ontario, and Alberta.

Verrallia virginica is contrasted with *aucta* Fallén as follows: 1) the middle femur has a posterior fringe of white pile, not black; 2) the hind femur has an apicoanterior fringe of white pile, not black; 3) the tarsi are brownish orange, especially the hind tarsus, not brownish black to black; 4) the scutellum has 3 pairs of marginal bristles, not 2 pairs; 5) the stigma is yellow (male) to hyaline (female), not black to brown; 6) the male 2nd antennal segment has white pile below, not black; 7) the male mesonotum is bluish gray pollinose, not brownish black; 8) the male 2nd tergum has extensive white pile laterally, not all black; and 9) the male wing is much more extensively bare, not almost completely microtrichose (this last character is apparently variable in female *virginica*). More detailed information on *virginica* will be given in a revision of the Nearctic species of *Verrallia* that is now being prepared.

I thank K. G. V. Smith of the British Museum (Natural History), London,

for the *aucta* material used and Janice Scott of the Museum of Comparative Zoology, Cambridge, for the loan of the holotype of *virginica*.

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NOTE

A NEW RECORD OF *Aedes* (*Stegomyia*) *patriciae* MATTINGLY (DIPTERA: CULICIDAE)

The receipt of additional material from Richard G. Andre, SEATO Medical Research Laboratory, Bangkok, Thailand, now allows me to report the presence of *Aedes* (*Stegomyia*) *patriciae* Mattingly in Selangor, Malaysia. In Southeast Asia it was previously known from Thailand (Chiang Mai, Songkhla, Tak) and Vietnam (An Khe). This new southern record from Selangor is of some importance to biologists and epidemiologists because of the ease with which *patriciae* can be confused with other members of the *albopictus* subgroup.

Aedes (*Stegomyia*) *patriciae* Mattingly

Aedes (*Stegomyia*) *flavopictus* Yamada, Barraud, 1931, Indian J. Med. Res. 19:224 (♂*); Barraud, 1934, Fauna Brit. India. 5:239 (♂*, ♀, L*) (misidentifications).

Aedes (*Stegomyia*) *patriciae* Mattingly, 1954, Ann. Trop. Med. Parasit. 48:262 (♂, ♀, P*, L); Huang, 1972, Contrib. Amer. Entomol. Inst. 9(1): 26 (♂*, ♀*, P*, L*); Danilov, 1976, Mosq. Syst. 8:253 (L). MALAYSIA. *Peninsular Malaysia: Selangor*—near Kuala Lumpur (V-1972, R. Andre), 2♂, 2♀, 1♂ terminalia, 4 individual rearings (4 l, 4 p).

Aedes patriciae is apparently confined to the Oriental region. It is presently known from India, southern China, Thailand, Vietnam and Malaysia.

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NOTES ON THE ETHOLOGY OF
ECCRITOSIA ZAMON (DIPTERA, ASILIDAE)^{1, 2}

Robert J. Lavigne

Abstract.—Adults of *Eccritosisia zamon* (Townsend) were collected resting on sand and vegetation bordering a stream in the State of Colima, Mexico. Matings took place, without courtship, in the male over female position. Oviposition occurred when the female inserted her ovipositor into vegetation-shaded sand.

Despite its large size and colorful appearance (black and orange), almost nothing has been recorded concerning *Eccritosisia zamon* (Townsend), with the exception of a few isolated distribution records.

Eccritosisia zamon was originally described by Townsend (1895) as *Proctacanthus zamon* from a series of 20 females and 37 males collected at San José del Cabo, Baja, California. It was apparently almost immediately confused with *Eccritosisia amphinome* Walker; Schaeffer (1916) records taking a specimen of the latter species in the Huachuca Mountains of Arizona, as well as noting that the Aldrich catalog (1905) listed it as occurring in lower California, Mexico, Guatemala and Honduras. Under the same name, Bromley (1934) recorded that R. H. Painter had noted it as occurring in the southwestern part of Texas. Apparently most of the original series was destroyed, but five specimens found their way to the American Museum of Natural History where they were rediscovered by Curran. Based on differences in genitalic structure, Curran (1934) was able to verify that *E. zamon* is a species distinct from *E. amphinome*, the latter occurring in Costa Rica and the Honduras. Using Curran's key, Wilcox (1937) suggested that the specimens recorded by both Schaeffer and Bromley were misidentified and Wilcox redescribed the species from specimens collected in Arizona. Bromley (1951) acknowledged his error and, from the series of specimens at the American Museum, he established a holotype and allotype. Bromley (1951) illustrated his paper with a photograph of *E. zamon* taken at Presidio, Texas on 1 September 1934. No further mention of this species appeared in the literature until Martin (1965), commenting on species whose center of distribution is in Mexico, noted that "*Eccritosisia zamon* (Townsend) ranges from Texas and Arizona as far south as Salina Cruz, Oaxaca in Southern Mexico, a distance of nearly 200 miles."

Specimens of *Eccritosisia zamon* were discovered in the same habitat as *Apiocera clavator* Painter (Lavigne, 1975) in vegetation bordering a stretch of sand along the edge of an unidentified stream, about 1 km east of El Centinela, Colima, Mexico. The turnoff (Camino Chavarin) to this semi-



Fig. 1. Male *Eccritotia zamon* resting on sand in early morning. Fig. 2. Mated pair of *Eccritotia zamon* resting on stem of *Mimosa pigra* L.

isolated village is about 16 km north of Manzanillo. The dominant vegetation bordering the sandy overflow area was *Mimosa pigra* L., a mesquite type of plant which grows in almost impenetrable clumps and to a height of about 3.05 m on this site.

The small population was observed over a period of six days, from 12-17 May 1973. On the first day, only one male was observed, none having been seen on 11 May. No females were observed until the morning of 14 May. During the period of observation the population reached approximately 20 individuals in number.

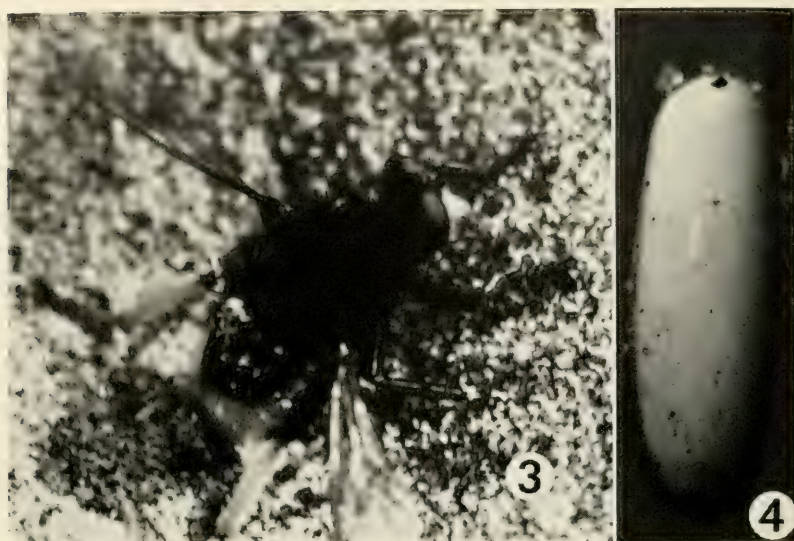


Fig. 3. Female *Eccritosis zamon* ovipositing in sand in the shade of a branch of a shrub willow. Fig. 4. Egg of *Eccritosis zamon*, magnified $50\times$, recovered from the sand.

Individuals were present, landing on the surface of the sand, when the author arrived daily, between 8 and 8:30 AM (Fig. 1). By approximately 11:10 AM all individuals in the population had completely disappeared, not to be seen again until the following morning. Attempts to follow individuals as they disappeared into the almost impenetrable *Mimosa* clumps were unsuccessful. Forays into the vegetation later in the day yielded no specimens.

Like other species of asilids studied, *Eccritosis zamon* responds to changes in substrate temperature by changing position. Normally when first seen in the morning, specimens were alighting on the surface of the sand. Sand surface temperatures at 8 AM were usually approximately 34°C , increasing to about $38\text{--}41^{\circ}\text{C}$ at 9 AM and to $\pm 50^{\circ}\text{C}$ by 10 AM. By the time this latter temperature was reached, all specimens observed had moved up onto vegetation at heights varying from 7.6 cm to 12.2 dm.

At no time during the six days of observation were any specimens observed with prey. On occasion, individual males were observed making flights in the direction of low-flying, dark brown hesperiid butterflies [probably *Urbanus simplicius* (Stoll)], but no contact was made. It is felt by the author that they were responding to a generalized female image rather than to a prey image. In all probability, foraging took place during the afternoon amongst the flowering *Mimosa* shrubs. The only prey ever recorded for this species were reported by Bromley (1934), apparently quoting a personal communication with R. H. Painter, the bombyliid spe-

cialist: "This species is said . . . to feed largely on Hymenoptera. 'Brownwood, Sept. 17, 1921, male with vespoid as prey; San Saba, Aug. 25, 1921, male with vespoid as prey' (R.H.P.)."

There is apparently no attempt at courtship in this species. The initiation of mating was observed only once, this in the air, although a second male was observed to attempt copulation unsuccessfully in this manner. On numerous occasions male-to-male aerial encounters were observed, indicating that males, unable to distinguish females because of their identical color pattern, were searching for the female image. During male-to-male encounter sequences, a male occasionally buzzed another male resting on the sand or upon encountering each other in flight, males circled each other several times with one male flying off, followed by another.

Mated pairs were observed on four occasions, the first two on the third day following the sighting of the first male by the author. The male lands on top of the female and the pair remain in this position throughout the mating act, flying from place to place in *copula* when disturbed. Once copulation takes place, the mated pair land on willow or *Mimosa* branches at heights ranging from 3–7.5 dm. All mated pairs were first observed between 8:46 and 9:47 AM with temperatures ranging from 30–35°C at that height. In the single instance where a complete mating was timed, the initiation of copulation occurred at 9:05 AM and separation occurred at 11:04 AM, a total of 119 minutes. During copulation the male rests with his fore tarsi on the dorsolateral angles of the front margin of the female's thorax. The male's mid tarsi cross the basal abdominal segments and the hind tarsi appear to grasp the female's wings (Fig. 2). The female's wings are spread to a 90° angle, while the male's wings remain closed throughout the act. Approximately 15 minutes after the initiation of mating, the female began pushing at the male genitalia with her hind tarsi, moving them rapidly. She repeated this act 12 times at intermittent intervals, usually cleaning the hind tarsi directly thereafter. However, she only cleaned her eyes and proboscis twice during the mating act.

Separation occurred on the branch with the male releasing his claspers and flying 3–4.5 dm. The female flew off immediately thereafter. The other three pairs observed separated in the same manner, without any prior movements to indicate the approaching end of the mating. The males did not buzz their wings at any time during the mating act, and on only one occasion did a male make any unusual movements. This was when the male vibrated his fore tarsi on the female's thorax 47 minutes into the complete mating.

Ovipositing females were observed on three separate occasions, all on the third day following the first sighting of a female. All observed ovipositions occurred between 8:47 and 10:10 AM on 14 May 1973. The ovipositor is inserted into the sand, accompanied by up and down movements of the

wings. The female's abdomen is completely inserted in the sand. Figure 3 shows a female in the process of removing her ovipositor from the sand. During oviposition the wings are spread to an approximate 90° angle. Removal of the ovipositor is accompanied by sweeping movements similar to those exhibited by *Stenopogon* sp. These movements result in sand being swept into the hole left by the ovipositor. Observed ovipositions were in areas shaded by willows or *Mimosa*, where temperatures beneath the surface of the sand ranged from 32–38° C. A single white egg, 0.5×1.5 mm, was recovered by sifting sand from the oviposition sites (Fig. 4).

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Footnotes

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A NEW GENUS AND NEW ASSIGNMENTS IN THE
AMERICAN CHOREUTIDAE (LEPIDOPTERA: SESIOIDEA)¹

John B. Heppner

Abstract.—*Caloreas*, new genus, is described and 18 New World species are transferred to it. Other New World species of *Choreutis* or "*Simaethis*" are assigned to *Anthophila*, *Brenthia*, *Choreutis*, *Eutromula*, *Hemcerophila*, *Tebenna*, and *Tortyra*, with 50 new combinations. Two species are transferred to Stenomidae and one species is transferred to Glyphipterigidae. One genus and 7 species are synonymized.

The genus *Choreutis* is heterogeneous as presently constituted, with species in North and South America belonging in several genera, including the new genus described below. To assign the Nearctic species for the forthcoming checklist fascicle of the series, *The Moths of America North of Mexico*, the systematic changes in *Choreutis* and related genera are presented here ahead of my revision of the Nearctic Choreutidae. Other New World species described in the conglomerate *Choreutis* or "*Simaethis*" (*Simaethis* is a synonym of *Anthophila*), are also assigned to several genera.

All described New World species of the genera noted herein are included, except for *Brenthia* and *Tortyra* where only the transferred species are noted. New assignments of the included species are based on examination of the type-specimens, rare exceptions involve lost types. The separation of Choreutidae from Glyphipterigidae has been discussed in another paper (Heppner, 1977).

Caloreas Heppner, new genus

Type-species.—*Choreutis apocynoglossa* Heppner, 1976.

Adults small (8-18 mm wingspread). Head: Frons smooth; vertex with scales loosely appressed; labial palpus upturned, with long scale tuft on segment 2; haustellum moderately scaled toward base. Thorax: Smooth-scaled; forewing with pterostigma; costal margin convex; apex rounded; tornus broadly rounded; anal margin convex; weak extension of M1 for chorda; veins R1 to R4 all to costal margin, R5 to termen; R3 free of R4 and R5 free of M1 at end on cell; M3 stalked with CuA1 at base; CuA1 and CuA2 parallel; CuP present near wing margin; hindwing costal margin convex; apex moderately pointed; tornus broadly rounded but distinct, forming triangular wing shape; Rs base becoming vestigial, with distal end to apex; M1-M3 parallel to termen; M3 short-stalked with CuA1 before end of cell. Abdomen: Male genitalia with uncus absent; large socius; gnathos absent; valva oblong, variously modified with apical projections

or simple; sacculus strong, with large setal field; usually a setal field below apex of valva; juxta-anellus as flat plate, with elongate end attached to saccus base; saccus large; aedeagus with phallobase; cornutus present; female genitalia with unspecialized ovipositor; papilla analis with well-defined, rounded edge; apophyses strong, of moderate length, occasionally short; ostium often large, sclerotized; ostium fused onto heavily sclerotized sternal plate of segment 7; bursa copulatrix often heart-shaped, attached to ductus bursae at distinct offset juncture to ventrum of bursa; signum usually present as spicule band between "heart" lobes of bursa and at ductus juncture; ductus bursae often sclerotized full length or partly; ductus seminalis junction at $\frac{1}{2}$ length from ostium; bulla seminalis small.

Caloreas is feminine in gender and is derived from the Greek for "beautiful mountain nymph" (*kalo* + *oreias*).

Discussion.—*Caloreas* is distinguished from *Tebenna* adults by the parallel CuA1 and CuA2 of the forewings and by M3 stalked basally with CuA1 in the hindwings. *Tebenna* has CuA1 and CuA2 curved toward each other at the termen of the forewings and lacks M3 in the hindwings. In *Choreutis* the forewing veins M3 and CuA1 are divergent at the termen and M3 and CuA1 are long-stalked in the hindwing. *Choreutis* also has R3 and R4, as well as R5 and M1, nearly fused at the end of the cell of the forewings. In wing maculation the three genera are similar, species of *Tebenna* being especially similar to many *Caloreas*. Wings of *Choreutis* species typically are more pointed at the apexes of the fore- and hindwings than in the other two genera, although *Choreutis extrinsicella* Dyar and *Choreutis pernivalis* Braun are unusual in having a wing shape nearly as in *Caloreas*. The genitalia and wing venation of these two species, however, are characteristic of *Choreutis*. Adults of *Caloreas* are diurnal fliers—as are all Choreutidae—and typically have areas of metallic iridescent scales on the forewings.

Almost all the species of *Caloreas* have an offset bursa similar to that illustrated by Heppner (1976) for *C. apocynoglossa* (Heppner). *Choreutis* species have a simple teardrop type of bursa-ductus bursae arrangement, as do typical *Tebenna* species. Of the *Caloreas* described thus far, only a few species have a bursa-ductus bursae arrangement differing from typical *Caloreas*: the bursa is similar but it is somewhat off-center in attachment to the ductus bursae and twisted 180° at the juncture of the ductus with the bursa. These untypical *Caloreas* show a development toward related species of *Tebenna*. This tendency to *Tebenna* is enhanced by the superficial similarity of the male genitalia, especially in *Caloreas leucobasis* (Fernald) and *Caloreas multimarginata* (Braun), to typical *Tebenna*.

Caloreas and related genera appear to have diverged among different plant families. *Caloreas* species have host plants mostly in Boraginaceae, while *Choreutis* species utilize Labiatae. *Tebenna* species utilize mostly Compositae, but there are a few host records in Umbelliferae and Scro-

phulariaceae. The related *Eutromula* have hosts in Betulaceae, Ulmaceae, Salicaceae, Ericaceae, and Rosaceae in temperate regions, with many species on Moraceae (*Ficus* spp.) in tropical areas. *Hemerophila* and *Tortyra* are known virtually only from *Ficus* (Moraceae). *Anthophila* hosts are mostly in Urticaceae. *Brenthia* hosts are in Fagaceae, Leguminosae, and Urticaceae. These host records are based on relatively few species, since most Choreutidae are not known biologically.

Caloreas has speciated to a great extent in the montane areas of western North America. In addition to the eight described Nearctic species, there are about 12 more *Caloreas* that are undescribed. The situation is similar in Nearctic *Tebenna* where about six species are undescribed.

The Neotropical *Simaethis chalybea* Felder and Rogenhofer is omitted from the checklist below, since its true position is not known: it may not belong in Choreutidae. *Anthophila fabriciana* (Linnaeus) is Palearctic and past reference to this species in the North American literature refers to the western *Anthophila alpinella* (Busck) or an undescribed species from eastern Canada. *Brenthia pavonacella* Clemens is not known from south of central Texas and reference to this species in the Neotropical literature refers to various other species of *Brenthia* which, while difficult to distinguish superficially, are easily distinguished by genitalic characters.

Checklist and New Combinations

The New World species described in *Choreutis*, "*Simaethis*," or related genera, are hereby segregated into their proper genera. Species with an asterisk are Neotropical. Species not in their original combination have the original genus indicated in brackets.

Anthophila Haworth, [1811]. Type-species: *A. fabriciana* (Linnaeus).

Simaethis Leach, 1815. Type-species: *A. fabriciana* (Linnaeus).

Anthophila alpinella (Busck, 1904) [*Hemerophila*]. New combination.

**Anthophila brachymorpha* (Meyrick, 1915) [*Simaethis*].

Brenthia Clemens, 1860. Type-species: *B. pavonacella* Clemens.

**Brenthia amatana* (Walker, 1863) [*Simaethis*].

**Brenthia confluxana* (Walker, 1863) [*Simaethis*].

**Brenthia depulsana* (Walker, 1863) [*Simaethis*].

**Brenthia suavis* (Felder & Rogenhofer, 1875) [*Choreutis*].

Caloreas Heppner, new genus. Type-species: *C. apocynoglossa* (Heppner).

Caloreas apocynoglossa (Heppner, 1976) [*Choreutis*]. New combination.

Caloreas augustella (Clarke, 1933) [*Choreutis*]. New combination.

**Caloreas blandinalis* (Zeller, 1877) [*Choreutis*]. New combination.

Caloreas caliginosa (Braun, 1921). [*Choreutis*]. New combination.

**Caloreas charmonica* (Walsingham, 1914) [*Porpe*]. New combination.

Caloreas coloradella (Kearfott, 1902) [*Choreutis*]. New combination.

**Caloreas cydrotia* (Meyrick, 1915) [*Choreutis*]. New combination.

- **Caloreas enantia* (Walsingham, 1914) [*Porpe*]. New combination.
- Caloreas hymenaea* (Meyrick, 1909) [*Choreutis*]. New combination.
- Caloreas lactibasis* (Walsingham, 1914) [*Porpe*]. New combination.
- Caloreas leucobasis* (Fernald, 1900) [*Choreutis*]. New combination.
- **Caloreas loxotenes* (Walsingham, 1914) [*Porpe*]. New combination.
- Caloreas multimarginata* (Braun, 1925) [*Choreutis*]. New combination.
- melanifera* (Keifer, 1937) [*Choreutis*]. New synonymy.
- Caloreas occidentella* (Dyar, 1900) [*Choreutis*]. New combination.
- **Caloreas pelinobasis* (Walsingham, 1914) [*Porpe*]. New combination.
- Caloreas schausiella* (Buseck, [1907]) [*Choreutis*]. New combination.
- **Caloreas tacubayella* (Kearfott, 1908) [*Choreutis*]. New combination.
- **Caloreas venusta* (Walsingham, 1914) [*Porpe*]. New combination.
- Choreutis* Hübner, [1825]. Type-species: *C. myllerana* (Fabricius).
- Choreutes* Treitschke, 1835, emendation.
- **Choreutis clemensella* (Walsingham, 1914) [*Porpe*]. New combination.
- Choreutis dyarella* Kearfott, 1902.
- Choreutis extrinsicella* Dyar, 1900.
- Choreutis inflatella* (Clemens, 1863) [*Brenthia*].
- virginiella* (Clemens, 1864) [*Brenthia*]. New synonymy.
- Choreutis pernivalis* Braun, 1921.
- Choreutis sororculella* Dyar, 1900.
- Eutromula* Frölich, 1828. Type-species: *E. pariana* (Clerck).
- Eutromula betuliperda* (Dyar, 1902) [*Orchemia*]. New combination.
- Eutromula diana* (Hübner, [1819–22]) [*Tortrix*].
- decorana* (Zetterstedt, [1839]) [*Coccyx*].
- luridana* (Walker, 1863) [*Amphisa*].
- vicarialis* (Zeller, 1875) [*Simaethis*]. New synonymy.
- Eutromula pariana* (Clerck, 1759) [no original combination].
- lutosa* (Haworth, [1811]) [*Anthophila*].
- Hemerophila* Hübner, [1817]. Type-species: *H. albertiana* (Cramer).
- Gauris* Hübner, 1821. Type-species: *H. albertiana* (Cramer).
- Walsinghamia* Riley, 1889. Type-species: *W. diva* Riley. New synonymy.
- **Hemerophila albertiana* (Cramer, [1781]) [*Phalaena Tortrix*].
- * *siphana* (Sepp, 1852) [*Phalaena*].
- * *zebra* (Walker, [1858]) [*Agrophila*].
- **Hemerophila arcigera* (Felder & Rogenhofer, 1875) [*Gauris*]. New combination.
- **Hemerophila biferana* (Walker, 1863) [*Gauris*].
- **Hemerophila bigerana* (Walker, 1863) [*Gauris*]. New combination.
- * *lacunaris* (Felder & Rogenhofer, 1875) [*Gauris*]. New synonymy.
- **Hemerophila canofusana* (Walker, 1863) [*Gauris*]. New combination.
- **Hemerophila chorica* (Meyrick, 1926) [*Tortyra*]. New combination.
- **Hemerophila cinctipes* (Felder & Rogenhofer, 1875) [*Gauris*].

- * *isthmia* Walsingham, 1914. [*Hemerophila*]. New synonymy.
- **Hemerophila contrariania* (Walker, 1863) [*Gauris*]. New combination.
- **Hemerophila contubernalis* (Zeller, 1877) [*Simaethis*].
Hemerophila diva (Riley, 1889) [*Walsinghamia*]. New combination.
- **Hemerophila felis* Walsingham, 1914.
- **Hemerophila gradella* Walsingham, 1914.
- **Hemerophila houttuinialis* (Cramer, [1781]) [*Phalaena Pyralis*].
- * *pulsana* (Walker, 1863) [*Gauris*].
- **Hemerophila immarginata* Walsingham, 1914.
- **Hemerophila lacinosella* Busck, 1914.
- **Hemerophila meratella* Busck, 1914.
- **Hemerophila milliaria* (Meyrick, 1922) [*Simaethis*]. New combination.
- **Hemerophila musicosema* (Meyrick, 1926) [*Simaethis*]. New combination.
- **Hemerophila ophiodesma* (Meyrick, 1915) [*Simaethis*]. New combination.
- **Hemerophila orinympha* (Meyrick, 1926) [*Simaethis*]. New combination.
- **Hemerophila rimulalis* (Zeller, 1875) [*Simaethis*].
dyari Busck, 1900 [*Hemerophila*]. New synonymy.
- **Hemerophila scenophora* (Meyrick, 1922) [*Simaethis*]. New combination.
- **Hemerophila triacmias* (Meyrick, 1926) [*Simaethis*]. New combination.
- **Hemerophila tristis* (Felder & Rogenhofer, 1875) [*Gauris*]. New combination.
- **Hemerophila velatana* (Walker, 1863) [*Gauris*].
- **Hemerophila xutholopa* Walsingham, 1914.
- Tebenna* Billberg, 1820. Type-species: *T. bjerkandrella* (Thunberg).
- Porpe* Hübner, [1825]. Type-species: *T. bjerkandrella* (Thunberg).
- **Tebenna alliciens* (Meyrick, 1926) [*Choreutis*]. New combination.
- Tebenna balsamorrhizella* (Busck, 1904) [*Choreutis*]. New combination.
- Tebenna carduiella* (Kearfott, 1902) [*Choreutis*]. New combination.
- busckiella* (Kearfott, 1902) [*Choreutis*]. New synonymy.
- **Tebenna chrysoterma* (Meyrick, 1932) [*Choreutis*]. New combination.
- **Tebenna fuscidorsis* (Zeller, 1877) [*Choreutis*]. New combination.
- Tebenna gemmalis* (Hulst, 1886) [*Chalcoela*]. New combination.
- Tebenna gnaphaliella* (Kearfott, 1902) [*Choreutis*]. New combination.
- Tebenna immutabilis* (Braun, 1927) [*Choreutis*]. New combination.
- **Tebenna lapidaria* (Meyrick, 1909) [*Choreutis*]. New combination.
- **Tebenna leptilonella* (Busck, [1934]) [*Choreutis*]. New combination.
- Tebenna onustana* (Walker, 1864) [*Simaethis*]. New combination.
- ohiensis* (Zeller, 1875) [*Choreutis*].
- Tebenna piperella* (Busck, 1904) [*Choreutis*]. New combination.
- Tebenna silphiella* (Grote, 1881) [*Choreutes* (sic)]. New combination.
- Tortyra* Walker, 1863. Type-species: *T. spectabilis* Walker.
- **Tortyra aurofasciana* (Snellen, 1875) [*Simaethis*].
- Tortyra slossonia* (Fernald, 1900) [*Walsinghamia*].

Species belonging to a new genus:

**Choreutis aeneigutta* Felder and Rogenhofer, 1875.

**Brenthia chrysosperma* Meyrick, 1931.

**Brenthia ochripalpis* Meyrick, 1920.

**Simaethis plutusana* Walker, 1863.

**Simaethis rutilella* Walker, 1863.

**Simaethis scintillana* Walker, 1863.

Species excluded and hereby transferred to other families:

Stenomidae

*"*Stenoma*" *albipes* (Felder and Rogenhofer, 1875) [*Simaethis*]. New combination.

*"*Stenoma*" *cyanastra* (Meyrick, 1909) [*Brenthia*]. New combination.

Glyphipterigidae

**Cronicombra lamella* (Busck, 1914) [*Porpe*]. New combination.

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Footnote

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TYPE-DESIGNATIONS AND OTHER NOTES CONCERNING
VELIIDAE (INSECTA: HEMIPTERA)¹

John T. Polhemus

Abstract.—Lectotypes are designated for *Microvelia americana* Uhler 1895, *M. circumcincta* Champion, *M. paludicola* Champion, *M. panamensis* Champion, *M. torquata* Champion, *M. signata* Uhler, *Rhagovelia distincta* Champion, and *Hebrus americanus* Uhler. As *Hebrus americanus* Uhler 1884 was transferred to *Microvelia*, *Microvelia americana* Uhler 1895 is a homonym; the next available name for the latter is *Microvelia gerhardi* Hussey. *Microvelia guatamalensis* McKinsty 1937 is synonymized with *M. circumcincta* Champion 1898. *Rhagovelia atrispina* is described as a new species and is compared with *R. distincta*. *Microvelia lacunana* Drake and Plaumann is transferred to the genus *Xiphovelia* (new combination) and is compared to the type of *Xiphovelia ensis* Lundblad. Emendations are given for previously published species names in the *Microvelia austrina* Group.

In connection with various projects involving American veliids, it has become evident that even the status of some of our commoner species is in doubt. In this work I have designated eight lectotypes, described a new species of *Rhagovelia*, and discussed the synonymy of several species. Additionally the genus *Xiphovelia* is noted for the first time in the New World.

I am indebted to the following people for their assistance in various ways during the preparation of this paper; the abbreviations for the various institutions are used to indicate the disposition of specimens examined: R. K. Benjamin, Rancho Santa Ana Botanical Gardens, Claremont; A. S. Menke and J. L. Herring, Systematic Entomology Laboratory, Agric. Res. Serv., USDA (USNM); H. E. Evans and D. Fronk, Colorado State University, Fort Collins; C. H. C. Lyal, British Museum (Natural History), London (BMNH); P. D. Ashlock, University of Kansas, Lawrence (KU); P. Robinson, University of Colorado Museum (CU); H. C. Chapman, Lake Charles, Louisiana (HCC); P. H. Arnaud, California Academy of Sciences, San Francisco (CAS); M. S. Polhemus, Spokane, Washington; B. Gustafsson, Riksmuseum, Stockholm; S. Miyamoto, Fukuoka. Types held in the Polhemus Collection (JTP) are irrevocably committed to later placement in a designated type repository.

Microvelia americana (Uhler)

Hebrus americanus Uhler, 1884. Standard Natural History, 2:274.

This species was described by Uhler (1884) in a large work on natural history that did not lend itself to the designation of a type. He took pains to point out that the species was not a *Microvelia*, a genus described by early authors as having six-segmented antenna and the tarsal formula 2-3-3. He did not designate a type, and did not give a type-locality with any exactness, stating only its occurrence in "the Middle States," Maine, and lower Canada. While there are several species that would fit his description, only one commonly occurs in the region given.

McKinstry (1933) attempted without success to locate the type in the U.S. National Museum and British Museum, however Dr. Herring has located the syntype series in the U.S. National Museum.

Uhler's original description seems sufficient to differentiate this species from other *Microvelia* commonly found in the region he described. Further, in 1910 Torre-Bueno described the life history of specimens from New York and New Jersey which he designated as *M. americana*, this apparently being the first official transfer of *Hebrus americanus* to *Microvelia*. In 1916 he described the legs and antennae in a way matching Uhler's description.

The primary differentiating characteristics of *Microvelia americana* (Uhler) are: Pronotum not produced caudad of suture separating pro- and mesotergum; hind tibia straight; ventral surface of 1st genital segment with bristly hairs; front femur not black or flattened; last abdominal tergum wider than long; 3rd antennal segment shorter than 4th.

Uhler did not designate syntypes, and while the series from his collection that is now before me unquestionably contains some or all of the specimens that he used to describe the species, the only one bearing a date has been chosen as lectotype. It is a male in a good state of preservation, on a point, with two labels: "N.H. 1881" in script, and a printed label "PR Uhler Collection." I have added a label: "Lectotype, *Hebrus americanus* Uhler 1884, J. T. Polhemus" (USNM).

Because of the lack of date labels, and different collection localities, I have not designated the remaining specimens as paralectotypes.

Microvelia gerhardi Hussey

Microvelia gerhardi Hussey, 1924. Bull. Brooklyn Entomol. Soc. 19:164 (type in Univ. Michigan Mus. Zool.).

Microvelia americana Uhler, 1895 (nec. Uhler, 1884). In Gillette and Baker, Hemiptera of Colorado, Agr. Exp. Sta. Bull. 31, Tech. Ser. 1, pp. 61-62. (Homonym of *Microvelia americana* (Uhler, 1884)).

Uhler, ignoring his previous description of *americana* under *Hebrus* in 1884, redescribed what he thought was this species in 1895 in a work on Colorado Hemiptera. A search has been made for the type-material in the Colorado State University Collections, the Baker collection at Pomona College, and the U.S. National Museum; fortunately, at the latter, Dr.

Herring located two male syntypes in the USNM portion of the Baker material. These bear only "Colo" and numbers on the labels, plus the Baker collection printed labels. Dr. H. E. Evans kindly located the original collection journals of both Gillette and Baker at Colorado State University and verified the collection data as that given by Uhler (1895). There are copies of the Gillette and Baker journals in the USNM which had previously allowed Dr. Herring to furnish collection data and verify that these specimens were indeed syntypes.

The specimen chosen as lectotype has two labels: "Colo 1406" and a printed "Collection C. F. Baker" label. To these will be added a label: "Lectotype, *Microvelia americana* Uhler 1895, J. T. Polhemus." For this specimen the Baker journal gives the following data: "1406. April Footh. W. Ft. Collins, Colo., CFB."

The other syntype has similar labels, except the number is 1407, which has a Baker journal entry: "March Footh. W. Ft. Collins, Colo., CFB." This specimen will be labeled as a paralectotype. Both are in the USNM.

Both males are in good condition, with all appendages intact. The numbered entries in Baker's journal before and after the 1406 and 1407 entries are given as 1894, so the date of collection seems firmly established as 1894. The entries in Gillette's journal for 1406 and 1407 refer to membracids, so although Uhler (1895) listed "(Gillette)" after the collection data, the data itself is recorded in Baker's journal.

When Torre-Bueno (1910) transferred *Hebrus americanus* Uhler 1884 to *Microvelia*, *M. americana* Uhler became a homonym, and as the two are not conspecific, the next available name for the latter is *Microvelia gerhardi* Hussey. Uhler's 1885 description noted that the legs are "yellowish-testaceous, with the femora, tibiae and tarsi dusky or piceous above," which fits *gerhardi* and the type-specimens very well.

Three species of the subgenus *Kirkaldya* inhabit Colorado (*beameri*, *gerhardi*, *torquata*) with perhaps *americana* also reaching the eastern border, but only *gerhardi* and *torquata* Champion have been found along the front range in the vicinity of Fort Collins. Of these *gerhardi* is by far the commonest, and *torquata* also lacks piceous leg markings. *Microvelia beameri* is found in the southwestern part of Colorado.

Microvelia circumcincta Champion

Microvelia circumcincta Champion, 1898. *Biologia Centrali Americana*. Rhynchota. 2:129.

Microvelia guatamalensis McKinstry, 1937. *J. Kan. Entomol. Soc.* 10:38. New synonymy.

Microvelia circumcincta has remained virtually unknown to recent American workers. McKinstry took no note of it when describing *M. guatamalensis*, which is a synonym. This species has the vertex barely raised above

the top margins of the eyes, lacks spines on both anterior and posterior femora, has slender legs, and is ordinarily dark dorsally with a transverse ferruginous band on the pronotum and a ferruginous line down the middle of the abdominal segments. The hairs bordering the ventral depression of the male 1st genital segment are of 2 lengths; those at the sides are much longer than those caudad.

I have studied the type-series of *circumcincta* and have selected a lectotype with the data given below. It is a female on the left side of a card bearing two females; I have placed an arrow and "type" below the lectotype. This is the lighter colored of the two females on this card and is the specimen figured by Champion. I have added my labels to the lectotype and two paralectotypes.

Material examined.—GUATEMALA: Lectotype (apterous ♀) and paralectotypes, 1♀ apterous, 1♀ alate, San Geronimo, Champion (BMNH); 1♂ apterous, El Salto Escuintla, 1934, F. X. Williams (paratype, *M. guatemalensis*) (KU). BELIZE: 4♂♂, 4♀♀ apterous, Mountain Pine Ridge, CL 641, xii-30-1973, J. T. Polhemus (JTP). MEXICO: Guerrero: 1♂ apterous, 40 mi N Acapulco, CL 1045, iv-26-1964, J. T. & M. S. Polhemus (CU). 1♂, 1♀ alate, Real de Arriba, Temascaltepec, H. E. Hinton & R. L. Usinger (HCC). Morelos: 1♂ apterous, 20 mi S Cuernavaca, CL 1047, iv-24-1964, J. T. & M. S. Polhemus (CU). Oaxaca: 1♂, 1♀ apterous, Tequisistlan, CL 1066, iv-30-1964, J. T. & M. S. Polhemus (CU). Puebla: 1♂ apterous, 7 mi W Izucar de Matamoros, CL 1050, iv-27-1964, J. T. & M. S. Polhemus (CU). Sinaloa: 2♂♂, 1♀ apterous, 1♂, 1♀ alate, Santa Lucia, iv-26-1974, M. S. Polhemus (JTP).

Microvelia paludicola Champion

Microvelia paludicola Champion, 1898. *Biologia Centrali Americana*, Rhynchota. 2:127.

Microvelia alachuana Hussey and Herring, 1950. *Fla. Entomol.* 33:117.

Microvelia paludicola Champion is a larger species than *M. torquata* Champion, with which it has been much confused, being more elongate and usually having a darker venter than the latter. The male first genital segment is also more elongate and has a ventral, proximal, longitudinal sulcus; both species lack hair tufts on this structure.

In southern populations (Mexico, Guatemala and for *paludicola*, Texas) of these two species, they can be readily separated by the light abdominal venter in *torquata* and the plumbeus venter in *paludicola*. Also *torquata* has the vertex of the head very convex, while it is much less so in *paludicola*.

I have studied the type-series of *paludicola* and selected a lectotype, the male of a male-female pair on a card with the data given below. I have added my lectotype label, in addition to the circular "type" label and

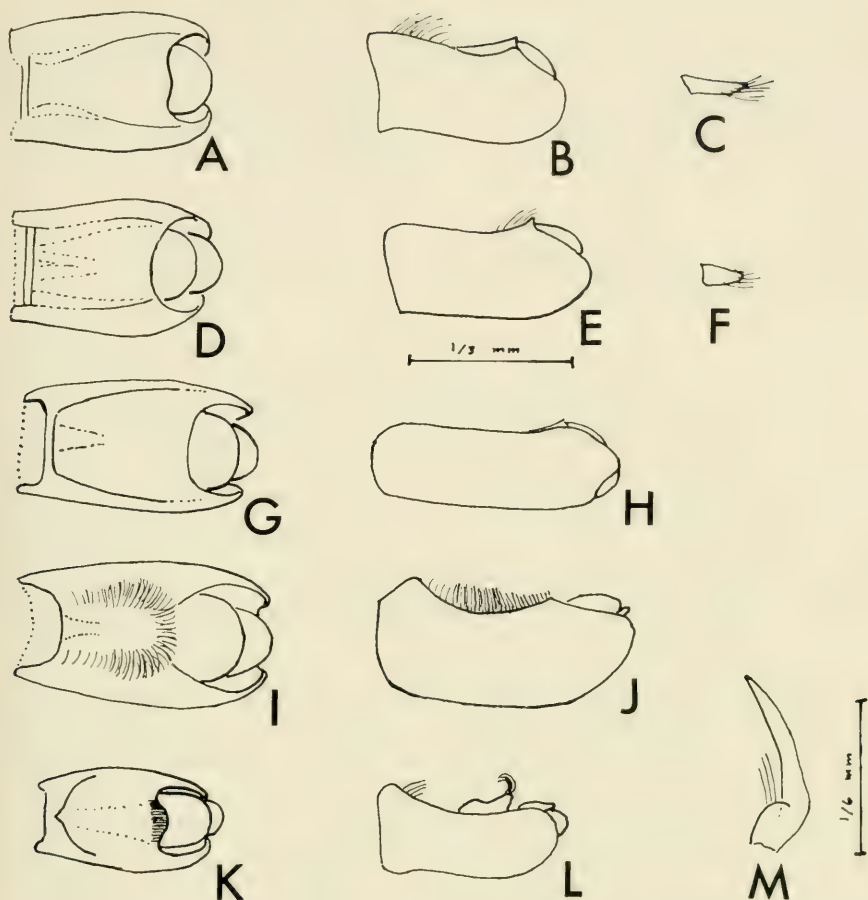


Fig. 1. A-L. *Microvelia*, male genitalia; A, D, G, I, K, genital capsules, ventral views; B, E, H, J, L, same, lateral views; C, F, right male parameres. A-C, *americana* Uhler. D-F, *torquata* Champion. G-H, *paludicola* Champion. I-J, *circumcincta* Champion. K-L, *panamensis* Champion. M, *Xiphovelia lacunana* (Drake and Plau-mann), right male paramere.

another with "B.C.A. Rhyn. II., *Microvelia paludicola* Ch." The three paralectotypes were also labeled.

Material examined.—GUATEMALA: Lectotype (alate ♂) and paralecto-types, 1♂, 2♀♀ alate, Duenas, G. C. Champion (BMNH); 4♂♂ alate, N of Patzicia, CL 1322, I-12-1970, J. T. Polhemus (JTP); 1♂, 1♀ apterous, 1♂, 4♀♀ alate, El Tapon area, CL 666, I-5-1974, J. T. Polhemus (JTP). MEX-ICO: Chihuahua: 1♂, 10♀♀ apterous, Camargo, CL 1005, iv-9-1964, J. T. & M. S. Polhemus (CU); 1♂, 1♀ alate, Camargo, vii-21-1951 Drake &

Hottes (JTP). UNITED STATES: Mississippi: 1♂, 1♂ apterous, Ocean Springs, v-25-1950, J. T. Polhemus (JTP). Texas: 1♂ apterous, El Paso, viii-27-1934, C. J. Drake (JTP); 1♂, 2♀♀ apterous, College Station, vi-26-1925, H. G. Johnston (JTP); 2♂♂, 3♀♀ apterous, Garner State Park, Nr. Uvalde, CL 600, xiii-8-1973, J. T. Polhemus (JTP). CUBA: 1♂, 1♀ apterous, R. Llojote, iii-21-1973, Decu & Hagen (JTP).

Microvelia panamensis Champion

Microvelia panamensis Champion, 1898. *Biologia Centrali Americana*, Rhynchota. 2:128.

This little species is very similar to *M. torquata*, differing primarily in the less strongly arched vertex of the head and the greatly different male genitalia (see Fig. 1). I have studied the type-series and selected a lectotype, with the locality data given below. The lectotype, which is the male figured in the *Biologia*, was removed from the card and placed on a point so I could study the ventral features. A female still resides on the original card, along with the original labels, so I copied the data and new labels as follows will be found with the lectotype: 1) David, Panama, Champion, 2) B.C.A. Rhyn. II. *Microvelia panamensis* Ch., 3) Sp. figured (this label is original). I have added my lectotype label, and also labeled the paralectotypes.

Material examined.—PANAMA: Lectotype (alate ♂) and paralectotype, 1♀ alate, David, Champion (BMNH); paralectotype, 1♀ apterous, V. de Chiriqui, 25–4,000 ft, Champion (BMNH); 1♂ apterous, Barro Colorado, C. Z., II-6-1939, C. J. Drake (JTP); 1♂, 1♀ apterous, Cerro Campana, v-7-1973, P. D. Ashlock (JTP); 1♂, 1♀ apterous, 3♂♂, 1♀ alate, El Valle, CL 1299, I-3-1969, J. T. Polhemus (JTP). COLOMBIA: 1♂, 1♀ apterous, 1♂ alate, Sierra Nevada de Santa Marta, Puebla Bello, 1,200 m, iv-14-1968, B. Malkin (JTP).

Microvelia signata Uhler

Microvelia signata Uhler, 1894. *Proc. Calif. Acad. Sci.* (2)4:288.

Microvelia setipes Champion, 1898. *Biologia Centrali Americana*, Rhynchota. 2:130.

Microvelia oreades Drake and Harris, 1928. *Ohio J. Sci.* 28:274.

Two specimens of this species bearing labels "San Esteban" and "Uhler type" are in the California Academy of Sciences. One of these bears a red label with "LECTOTYPE *signata*" and a label with "*Microvelia signata* Uhler" in script. The other has a yellow label with "PARATYPE *signata*." This lectotype was apparently designated by Van Duzee (communication from Dr. Paul Arnaud) but is invalid because it was never published.

I have added my own lectotype and paralectotype labels to these specimens and here validate the designation.

Specimens from *signata* bearing a printed label "San Esteban, Lower Cal. Mex., Chas. D. Haines, April 1889" and "*Microvelia signata* Uhler" in Uhler's handwriting have been found in the collections of the USNM and are also considered paralectotypes. These two specimens, on one long card on a single pin, are so labeled.

Lectotype material.—MEXICO: Baja California: Lectotype, ♂, macropterous, San Esteban; Paralectotype, ♂, macropterous, San Esteban (both in CAS). Paralectotypes, 2♀♀, San Esteban, April 1889, C. D. Haines (USNM).

Microvelia torquata Champion

Microvelia torquata Champion, 1898. Biologia Centrali Americana, Rhynchota. 2:128.

North American workers have confused this species with *M. paludicola* Champion, with the exception of McKinstry (1933) who diagnosed it correctly in his unpublished thesis. *Microvelia torquata* is a variable species for which I have established a series from Guatemala to Arizona, Utah and Colorado. The venter of the first male genital segment is without hair tufts, is slightly depressed medially, has a proximal longitudinal median carina flanked by depressions extending one third the length distally, and often has a glabrous spot distally. The vertex of the head is quite convex and elevated above eye level.

A clinal variation exists from the deserts to the mountains in the southwest U.S., with the mountain forms tending toward shorter antennae, dark abdominal venter and slightly more robust body shape. The mountain populations were first considered to be a separate species, but the examination of a number of series shows a gradual shift of character states from the desert to the mountains; the variation within some series is also pronounced. The male genitalia are not different in the mountain populations. The silvery patches of hair, often helpful in diagnosis of water striders, are quite variable in this species, even within a given series, so are not reliable for the separation of *torquata*. The antennal ratio also varies considerably, even within a series.

I have examined the type-series from the British Museum and have selected the male figured by Champion as the lectotype, with the data given below. I have added labels to the lectotype and single paralectotype. This specimen was glued on a card, with the distal two segments of each antenna detached but also glued to the card; the specimen was removed and placed on a point, but the distal antennal segments remain on the

card. In addition to the locality label, the type bears a round "type" label and one with "B.C.A. Rhyn. II. *Microvelia torquata* Ch."

Material examined.—GUATEMALA: *Lectotype* (♂, alate) and paralectotype, 1♀ alate, Geronimo, Champion (BMNH); 1♂, 1♀ apterous, 38 mi S Huehuetenango, CL 1325, I-13-1970, J. T. Polhemus (JTP). MEXICO: Chiapas: 1♂, 2♀♀ apterous, 16 mi S San Cristobal, CL 1079, 2 May 1964, J. T. & M. S. Polhemus (CU); 1♂, 1♀ alate, 3♂♂, 2♀♀ apterous, same place, CL 1330, I-14-1970, J. T. Polhemus (JTP); 1♂, 2♀♀ apterous, 2 mi W Montebello Lakes, CL 1081, 2 May 1964, J. T. & M. S. Polhemus (CU). Jalisco: 1♂ apterous, 15 mi S Ixtlan del Rio, CL 1029, 22 April 1964, J. T. & M. S. Polhemus (CU). Michoacan: 1♂, 3♀♀ apterous, Jacona, CL 1032, 23 April 1964, J. T. & M. S. Polhemus (CU). San Luis Potosí: 1♂ apterous, Ciudad del Maiz, CL 528, I-4-1971, J. T. & M. S. Polhemus (JTP). Sinaloa: 2♂♂ alate, 2♂♂, 1♀ apterous, Santa Lucia, iv-26-1974, M. S. Polhemus (JTP). Sonora: 1♂, 2♀♀ apterous, Guaymas, CL 1207, V-28-1966, J. T. Polhemus (JTP). Veracruz: 1♂ apterous, Alvarado, vii-28-1951, Drake & Hottes (JTP). UNITED STATES: Arizona: 2♂♂, 2♀♀ apterous, 1♂, 1♀ alate, Grand Canyon, Havasu Creek, CL 555, vi-2-1972, J. T. & M. S. Polhemus (JTP); 2♂♂, 1♀ apterous, 1♂ alate, Sabino Canyon, CL 497, xi-27-1970, J. T. Polhemus (JTP). Colorado: 3♂♂ apterous, Denver, CL 26, iv-17-1961, J. T. Polhemus (JTP); 2♂♂, 4♀♀ apterous, Hygeine, CL 171, iv-7-1963, J. T. Polhemus (JTP). New Mexico: 3♂♂, 7♀♀ apterous, Glenwood, CL 319, iv-16-1965, J. T. Polhemus (JTP); 4♂♂, 5♀♀ apterous, Mountain Park, CL 90, iv-14-1962, J. T. Polhemus (JTP). Utah: 2♂♂, 3♀♀ apterous, Zion Nat. Pk., CL 282, II-22-1964, J. T. Polhemus (JTP). (Some of these series contained many more specimens; those listed here were examined closely and/or measured.)

Rhagovelia distincta Champion

Rhagovelia distincta Champion, 1898. *Biologia Centrali Americana*, Rhynchota. 2:135.

Rhagovelia mexicana Signoret, 1877. *Bull. Soc. Entomol. Fr.* 7(5):53.

Rhagovelia excellentis Drake and Harris, 1927. *Proc. Biol. Soc. Wash.* 40:134.

I have studied the syntypes of this species belonging to the British Museum. Other syntypes are listed as belonging to the Vienna Museum, but I have not seen them. From the series in hand I have chosen a lectotype, being the left male of a carded pair of males, marked it with an arrow and "Lect." on the card, and added my lectotype label below. In addition, there is a round "type" label, one with "H.H.S., Orizaba, Mexico," and another with "B.C.A. Rhyn. II., *Rhagovelia distincta* Ch. ♂."

There are 10 paralectotypes before me, that I have so labeled, plus 2 nymphs on one card.

Material examined.—MEXICO: Lectotype (apterous ♂) and paralectotypes 4♂♂, 2♀♀ apterous, Orizaba, H. H. S.; paralectotype, 1♀ alate, Orizaba, Dec. 1877, H. S. & F.; paralectotypes, 1♂, 2♀♀ apterous, Ciudad Mex., 8,100 ft, Forrer. (All in BMNH.)

(Many hundreds of specimens from numerous localities have been studied, but the species is adequately treated by Bacon (1956), so my voluminous records are here omitted for the sake of brevity.)

Rhagovelia atrispina Polhemus, new species

Male.—Robust, black, wedge-shaped brownish to grey spot on each side of pronotum, reaching laterally just past inner margin of eye; connexival margins, base of 1st antennal segment, proepisternum, acetabulae, trochanters, bases of fore and posterior femora yellow brown; medial portion of 7th tergum, 1st genital segment ventrally, testaceous. Dorsum covered with sparse silvery pubescence and scattered silvery setae laterally on abdomen; pleura set with semilong dark setae laterally. Venter plumbeus with fine golden pubescence.

Head with glabrous median furrow meeting a wedge-shaped glabrous spot posteriorly. Width of eye interocular space, 22 15. Rostrum reaching almost to middle coxae.

Pronotum long, coarsely pitted, covering mesonotum; lateral margins almost straight, converging anteriorly, posterolateral angles broadly rounded; length/width, 68 87. Abdominal terga all broadly shining, first 6 subequal in length, 7 about 2.5× the length of 6 and subequal to length of 1st genital segment. Connexiva obliquely raised, narrowing caudad, without spines or processes.

Abdominal tergum 7 depressed on posterior $\frac{2}{3}$, the depression bordered laterally by stiff setae as in *Rhagovelia distincta*.

Antennae moderately long, stout, clothed with short setae and scattered long black setae, proportions I–IV, 60:35:40:35. Fore tibia flattened and weakly dilated distally, with short tibial comb. Fore trochanter with an anteriorly directed stout black spine. Posterior trochanter with 6–8 small black spines. Posterior femur with 12–18 small teeth basally, followed just past basal $\frac{1}{3}$ by a large spine and 10 moderate spines of decreasing length distally. Posterior tibia armed with short subequal teeth and apical spur. Measurements of legs:

	Femur	Tibia	Tarsal 2	Tarsal 3
Anterior	85	85	—	21
Middle	146	105	57	59
Posterior	120	118	17	26

Male paramere very similar to *R. distincta* as figured by Bacon (1956) but with thicker, longer setae.

Length 4.25 mm, width (across metanotum) 1.65 mm.

Female.—Similar in coloration to male. Abdomen strongly narrowed after first 3 segments, connexivum reflexed and almost meeting over tergum 5, diverging weakly caudad. Abdominal terga 6 and 7 weakly carinate longitudinally, 7 with a tuft of stiff posteriorly directed setae caudad. Abdomen curving upward posteriorly to a 45° angle from the longitudinal body axis. Middle femora flattened over basal $\frac{1}{2}$. Posterior femur armed at apical $\frac{1}{3}$ with a stout spine followed by 4 or 5 short spines; posterior tibia unarmed. Length, 4.6 mm; width (across metanotum), 1.9 mm.

Material examined.—MEXICO: Holotype, apterous ♂, and allotype, apterous ♀, Michoacan, Jacona, CL 743, VI-12-1975, J. T. Polhemus. Paratypes as follows: Michoacan: 26♂♂, 54♀♀ apterous, 8♂♂, 24♀♀ alate, same data as holotype (JTP); 23♂♂, 17♀♀ apterous, 17♂♂, 5♀♀ alate, Jacona, CL 1032, 23 April 1964, J. T. & M. S. Polhemus (CU, JTP); 18♂♂, 8♀♀ apterous, 8♂♂, 3♀♀ alate, 22 mi W of Patzcuaro, CL 1033, 23 April 1964, J. T. & M. S. Polhemus (CU, JTP); 1♂, 2♀♀ apterous, 5♂♂, 10♀♀ alate, nr. Tacambaro, CL 746, VI-14-1975, J. T. Polhemus (JTP). Sinaloa: 1♂ apterous, 2♂♂, 4♀♀ alate, Santa Lucia, CL 1019, 20 April 1964, J. T. & M. S. Polhemus (CU, JTP).

Discussion.—This species is closest to *Rhagovelia distincta* Champion, which has a very wide geographic range, from Guatemala and Honduras to Wyoming and Utah in the United States. Gould (1931) proposed six varieties for various forms of *distincta* from the western U.S. and Mexico, but these were suppressed by Bacon (1956). *Rhagovelia atrispina* is darker than any of the *distincta* varieties proposed by Gould and is easily distinguished by the black spine on the fore trochanter, by the more distal placement of the large tooth and by the larger number of small basal teeth on the posterior femur.

So far, *atriospina* and *distincta* have not been found sympatrically, but they occur within a short distance of each other in the Sierra Madre Occidental. As no intergrades have been seen, I prefer to treat *atriospina* as a new species rather than subspecies.

Xiphovelia lacunana (Drake and Plaumann), new combination

Microvelia lacunana Drake and Plaumann, 1953. Dusenica. 4:415.

To date no true members of the genus *Xiphovelia* Lundblad have been recorded from the New World. Drake and Harris (1936) transferred their *Microvelia diffidens* and *M. turmalis* to *Xiphovelia*, but in 1955 Herring erected the genus *Husseyella* to hold them. I find, however, that *M. lacunana* is a true *Xiphovelia*.

I have studied the types of *Xiphovelina ensis* Lundblad, and three species of Asian *Xiphovelina* for comparison; and except for the saber-like paramere and the lack of apterous specimens, *lacunana* is a typical *Xiphovelina*, with the body dorsoventrally compressed and the head and eyes closely appressed to the pronotum.

Material examined.—BRASIL: 1♀, Matto Grosso, 1953 (paratype) (JTP); 1♂, Linha Façao, St. Catarina, V-1957 (JTP); 1♂, Nova Teutonia, III-1962; 101 specimens, Nova Teutonia, XI-1961, F. Plaumann (JTP). (All specimens are macropterous.)

An Emendation of Names in the *Microvelina austrina* Group

I recently published new taxa (Polhemus, 1974) in the *M. austrina* Group which, through various errors, are either misspelled or incorrectly formed. They are emended as follows:

Originally published name (all in <i>Microvelina</i>)	Emendation or correction
<i>leavipleura</i>	<i>laevipleura</i>
<i>laevepleura</i>	
<i>glabrosulcata</i>	<i>glabrosulcata</i>
<i>glabrosulcuta</i>	
<i>depressus</i>	<i>depressa</i>
<i>reflexus</i>	<i>reflexa</i>

I am indebted to G. C. D. Griffiths for calling my attention to the errors, and to J. L. Herring, A. L. Menke and G. C. Steyskal for helpful comments.

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Footnote

¹ Contribution from the University of Colorado Museum and Department of Environmental Population and Organismic Biology, University of Colorado, Boulder, 80302.

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NOTE

RICHARDIA EBURNEOSIGNATA HENNIG (DIPTERA:
RICHARDIIDAE), A NEW RECORD FOR
THE GENUS NORTH OF MEXICO

A fine male specimen of *Richardia eburneosignata* Hennig was determined recently out of a lot submitted my Howard V. Weems, Jr., of the Florida State Collection of Arthropods, Gainesville. The specimen was taken by Fred C. Harmston at Rio Grande City, Starr County, Texas, in October 1967. Permission to deposit this specimen in the U.S. National Museum Collections is much appreciated.

This species is the northernmost known of its genus; the previous northernmost record of which I am aware is Xilitla, San Luis Potosí, Mexico, about 500 km south of Rio Grande City.

The genus *Richardia* is easily recognized by hindfemora considerably more swollen than the others. The species is recognized by a single brown transverse band through both crossveins and a brown spot on the tip of the wing; the dorsum of the thorax is mostly black and bears longitudinal whitish and brown stripes of tomentum; the posterior margin of the mesopleuron has a creamy white wedge of ground color; and the abdomen is largely metallic blue. Nothing is known of the habits of the species, or indeed of the genus.

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A NEW CACTUS-FEEDING BUT SOIL-BREEDING SPECIES
OF *DROSOPHILA* (DIPTERA: DROSOPHILIDAE)

William B. Heed

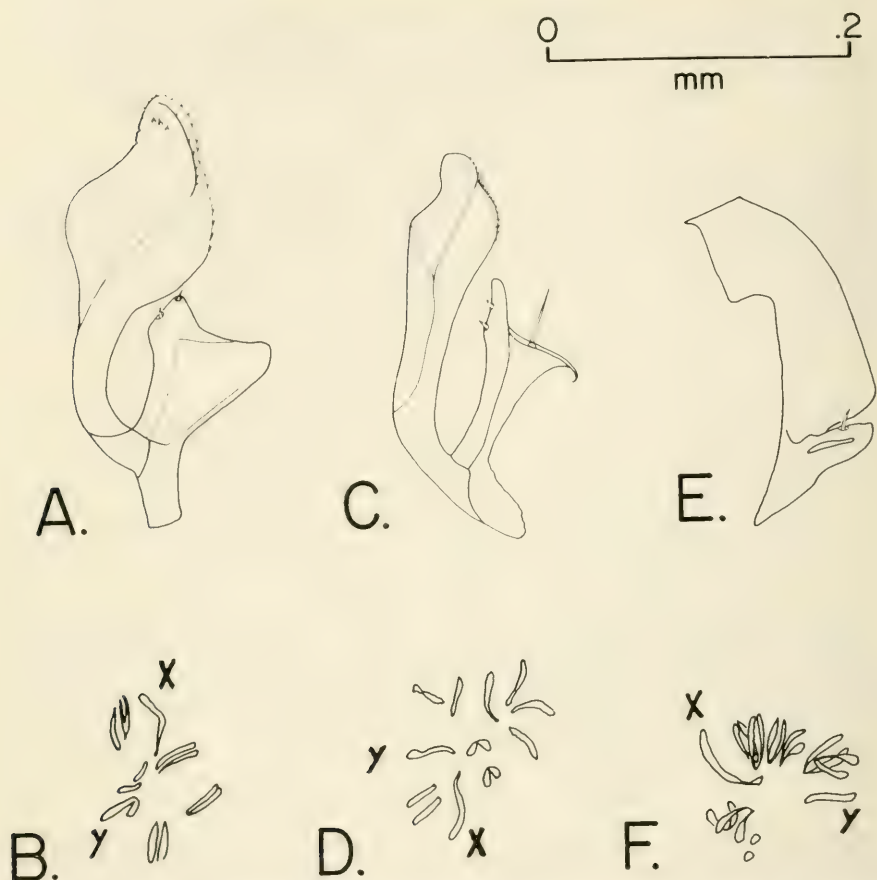
Abstract.—A new species of *Drosophila*, *D. mettleri*, is described from the Sonoran Desert. It is most closely related to *D. eremophila* Wasserman which belongs to the *mulleri* subgroup of the *repleta* species group of the subgenus *Drosophila*. Its most distinguishing characteristic is its habit of breeding in soil saturated by juice from the necrotic tissues of its host plants of the genera of columnar cacti, *Carnegiea* and *Pachycereus*.

This species was first observed in a banana-baited collection of *Drosophila* in October 1961, at San Felipe, Baja California. It has since been recognized as one of the four endemic species of *Drosophila* of the Sonoran Desert where the adults may be regularly collected in association with *D. nigrospiracula* Patterson and Wheeler from certain species of decaying columnar cacti. The species is morphologically very similar to *D. nigrospiracula* but it is not closely related to it. The species has been reported as *Drosophila* M or as *D. nigrospiracula*-like in the following publications: Heed et al., 1962; Johnston and Heed, 1971; Fellows and Heed, 1972; Kaneshiro et al., 1973; Jefferson et al., 1974; Heed et al., 1976; and Starmer et al., 1976. The description of the new species follows.

Drosophila mettleri Heed, new species

External characters of imagines.—♂ ♀, arista with 3-4 dorsal rays in addition to terminal fork. Third antennal segment and face yellowish brown. Carina wider below and slightly sulcate. Frons pollinose, golden brown in pinned specimens, somewhat elongated anteriorly with a central irregular cluster of 15-20 bristles and 6 bristles at anterior edge. Anterior proclinate bristle about same length as posterior reclinate. Mid-orbital $\frac{1}{3}$ - $\frac{2}{3}$ posterior. Eye almost round, dark red (maroon). Cheek very wide, about $\frac{1}{2}$ greatest diameter of eye, light brown. One strong oral with 2-3 suborals.

Mesonotum ground color pollinose lichen-gray (pinned specimens) with a dark brown spot at base of acrostichal hairs. Many spots fused forming irregular pattern. Eight acrostichal hair rows between dorsocentral bristles. Anterior scutellar bristles convergent. Pleural region dark gray. Anterior sternopleural $\frac{7}{10}$ length of posterior; mid-sternopleural $\frac{1}{3}$ or more posterior. Femora dark brown, remainder of legs light brown. Wing clear, costal index about 3.3; 4th vein index about 1.5; 5th index about .9. Third costal section with heavy bristles on basal $\frac{1}{5}$ - $\frac{1}{4}$. Abdomen with wide blackish bands very slightly interrupted on mid-dorsal line and extending to lateral margins.



Figs. A and B. *Drosophila mettleri*, Tucson, Arizona. A, lateral view of aedeagus with part of hypandrium attached to gonapophysis. B, larval brain cell metaphase. Figs. C and D. *Drosophila eremophila*, Navojoa, Sonora, Mexico. C, lateral view of aedeagus with part of hypandrium attached to gonapophysis. D, larval brain cell metaphase. Figs. E and F. *Drosophila nigrospiracula*, Tucson, Arizona. E, lateral view of aedeagus. F, larval brain cell metaphase.

Body length (etherized), 2.5–3.2 mm (♂), 2.7–3.7 mm (♀); wing length 2.5–3.2 mm (♂), 2.5–3.4 mm (♀).

Internal characters of imagines and genitalia.—Posterior tips of Malpighian tubules fused with continuous lumen. Testis with $3\frac{1}{2}$ orange coils; two orange coils in the differentiated section of the vas deferens. Testes become dark red with age. Claspers rounded with 11–12 primary teeth and no secondary teeth; about 15 heavy bristles on anterior margin. Tip of anal plate slightly elongated with a cluster of 3–5 bristles. Genital arch with

slightly rounded protrusion over claspers and with elongated toe extending beyond claspers. Novasternum with one heavy bristle and gonapophysis with two short bristles in tandem at terminal end. Aedeagus rounded in lateral view with no projections, apodeme short (Fig. 1). Stalks of spermathecae relatively long and weak. Capsule of spermatheca weakly sclerotized and somewhat crumpled. Ventral receptacle relatively short with a few basal coils and about 15 irregular folds distally where the diameter is much narrower. Ovipositor plate slightly blunted at tip with about 19 bristles.

Egg.—Two pair of long thin filaments about $1.5-2\times$ length of egg.

Larva.—Third instar mouth hooks are finely serrated under high magnification but with no teeth. The larvae are photonegative.

Puparium.—Tan color; horns, including the yellow spiracles, short, about $\frac{1}{2}$ length of pupa. Spiracles number 13, about same length as the stalk.

Chromosomes.—Six pairs of rods. The X is the longest rod and the shortest rod represents the dot chromosome with added heterochromatin. It is approximately $\frac{2}{3}$ length of the X. The Y is $\frac{2}{3}$ length of X and is J-shaped. Salivary chromosomes show 5 arms and a heavily heterochromatized dot.

Distribution and ecology.—Breeds in the soil saturated with fermenting cactus juice from three columnar cacti (*Carnegiea gigantea* (Engelmann) Britton and Rose (saguaro), *Pachycereus pringlei* (S. Watson) Britton and Rose (cardon) and *Pachycereus pecten-arboriginum* (Engelmann) Britton and Rose (hecho)) in the Sonoran Desert of Arizona, Baja California and Sonora, Mexico, where they occur. The species is invariably associated with *D. nigrospiracula* which breeds in the necrotic tissues of these plants.

Relationship.—Belongs to the *mulleri* subgroup of the *repleta* species group of the subgenus *Drosophila* and is most closely related to *D. eremophila* Wasserman from which it may be distinguished by the larger size, metaphase chromosomes, breeding biology and distribution. The metaphase chromosomes of *D. eremophila* have a pair of short heterochromatic V's in place of the short rods of *mettleri* and the Y is shorter and not J-shaped. The author has examined the metaphase of *D. eremophila* from Guayalejo, Tamaulipas, Mexico, and from Navojoa, Sonora, Mexico. They are almost identical and differ from the type-material from Acatlan, Puebla, as reported by Wasserman (1962), by the length of the Y. In strains from the former two localities the Y is about $\frac{1}{2}$ length of the X while it is only dot-sized in the material from Acatlan.

The banding sequences on the polytene autosomes of *mettleri* are identical (homosequential) with those of *eremophila*. The X chromosome has not been interpreted (Wasserman, personal communication).

Drosophila eremophila adults are associated with *Opuntia* pads in Navojoa, Sonora, but they have never been reared from them. It is assumed they breed in the soil because of their close relationship to *D. mettleri*

Table 1. Distribution of adults and larvae of *Drosophila mettleri* and *D. nigrospiracula* on saguaro.

	Aspirated on ground		Aspirated on cactus		Eclosed in laboratory		Days to eclosion
	♀	♂	♀	♂	soil	cactus	
<i>D. nigrospiracula</i>	1	1	27	38	0	2,208	6-22
<i>D. mettleri</i>	19	9	9	59	534	0	8-17

and especially in the close resemblance in shape of the larval mouth hooks. The two species are known to be sympatric in the locality of Empalme, Sonora.

Types.—Holotype male and paratypes from Tucson, Arizona, deposited in the U.S. National Museum, Washington, D.C. Other paratypes deposited in the National *Drosophila* Species Resource Center, University of Texas, Austin, Texas. The species is named in honor of Dr. Lawrence E. Mettler in recognition of his outstanding contributions to our knowledge of Sonoran Desert *Drosophila*.

Discussion

Drosophila mettleri is an interesting species in several respects. Primarily it represents one of the first cases in the genus *Drosophila* in which larvae and pupae are found in the soil and thus demonstrates a distinct niche separation from *D. nigrospiracula* whose larvae and pupae exist in the necrotic tissues of the parent cacti.

On 2 March 1972, *D. mettleri* larvae were first discovered in the soil by J. Spencer Johnston and the author. Table 1 shows a typical sample distribution of adults and larvae of the two species from a saguaro near Tucson. *Drosophila nigrospiracula* adults prefer to feed on the cactus while *D. mettleri* are found both on the soil and on the cactus. Females of *D. mettleri* are more abundant on the moist soil where they lay eggs. There is no overlap in this case between species reared from the soil and the cactus even though the cactus was collected immediately above the soil. There is a difference of emergence time of two days between the species; *D. mettleri* develops more slowly.

The other well studied case of paired species in a host plant and its soil exists in the Island of Hawaii in the extremely arid *Myoporum* forest of the Pohakuloa area at 6,000 feet elevation (Kaneshiro et al., 1973). However, in this case the two species, *D. silvarentis* Hardy and Kaneshiro (which breeds in the tree flux) and *D. heedi* Hardy and Kaneshiro (which

breeds in the moist soil beneath the flux) are considered to be very closely related. The two species in the Sonoran Desert are not each other's closest relatives. However, the common dimension in both cases is the arid condition in which they exist. Niche separation, as opposed to niche overlap, appears to be an ecological characteristic of more arid areas.

Secondly, the very close similarity in external features of the adults of *D. mettleri* and *D. nigrospiracula* must be the result of selection for a common phenotype (parallelism). This can be readily understood since the adults of both species feed side-by-side in an exposed condition on the necrotic tissues of their hosts. *Drosophila nigrospiracula* may be distinguished from *D. mettleri* by the following characters: (1) frons pollinose brownish black with a V-shaped row of approximately eight bristles, (2) there is no extension (toe) from the genital arch (δ), (3) aedeagus with a very poorly developed gonapophysis, (4) third-instar larval mouth hooks distinctly toothed, (5) anterior horns, including spiracles, about $\frac{1}{3}$ length of pupa; spiracles black, and (6) chromosomes, five pairs of rods and a pair of large dots. The Y is a rod and is over $\frac{1}{2}$ length of the X (Figs. B, D, F).

Drosophila mettleri sometimes overlaps *D. nigrospiracula* in the following characters which are listed for *nigrospiracula*: Larger size, blacker body, narrower cheek and more elongated and proportionately larger eye.

Acknowledgments

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Notice of a New Publication

Pictorial Key to Species of the Genus *Anastrepha* (Diptera: Tephritidae)

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A total of 155 species in the genus *Anastrepha* are covered in this pictorial key which contains over 200 illustrations in its 36 pages. A list of the species described since Alan Stone's (1942) revision of the genus is included as well as new synonymy and an index to those species discussed.

This publication is available for \$1.50 and can be ordered from the Custodian, Entomological Society of Washington, c/o Department of Entomology, Smithsonian Institution, Washington, D.C. 20560.

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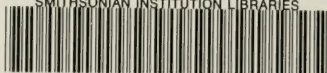
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